Illustrated manual of operative surgery and surgical anatomy / by Ch. Bernard and Ch. Huette ; edited, with notes and additions, and adapted to the use of the American medical student, by W.H. Van Buren and C E. Isaacs ; illustrated with steel engravings, from drawings after nature by M.J. Lévillé ; designed to serve as a companion to the ordinary text books of surgery.

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Francis A. Countway Library of Medicine

Publication/Creation

New York : H. Bailliere, 1855 (New York : W.H. Tinson)

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ILLUSTRATED MANUAL

OF

OPERATIVE SURGERY

AND

SURGICAL ANATOMY.

BY

MM. CH. BERNARD, D.M.P., AND CH. HUETTE,

EDITED, WITH NOTES AND ADDITIONS,

AND ADAPTED TO THE USE OF THE AMERICAN MEDICAL STUDENT,

BY

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ILLUSTRATED WITH STEEL ENGRAVINGS, FROM DRAWINGS AFTER NATURE,

BY M. J. LÉVEILLÉ.

DESIGNED TO SERVE AS A COMPANION TO THE ORDINARY TEXT BOOKS OF SURGERY.

NEW YORK:
H. BAILLIERE, 290 BROADWAY,
AND 219 REGENT STREET, LONDON.
PARIS: J. B. BAILLIERE, RUE HAUTEFEUILLE
1855.

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PREFACE TO THE AMERICAN EDITION.

In presenting to the American Student of Surgery the beautifully illustrated work of MM. Bernard and Huette, the editors flatter themselves that they have contributed to the supply of a want which has not been unfrequently experienced heretofore, viz.: a complete and concise picture of the science and art of Operative Surgery, in its present advanced and perfected condition, in a portable form. The admirable and extensive works of Bourgery and Jacob, and Prof. Velpeau, with the translation of the latter under the auspices of Prof. Mott, and the equally excellent treatise on Operative Surgery by Prof. Pancoast of Philadelphia, can never be replaced by the present work. Yet its compactness and portability will render it more desirable to the student as a companion in the lecture and dissecting room, where its copious and graphic illustrations will assist him materially in acquiring correct general ideas as to the nature and objects of the individual operations of surgery; whilst for more minute and varied details with regard to their history and numerous modifications, the less accessible and more expensive treatises alluded to can be consulted at a more advanced period of study. In fact they are better calculated for works of reference to the practitioner of surgery, than as text books for the student, designed to set forth concisely the elements of the art. Our manual, whilst it is intended mainly to illustrate the intri-

cacies of operative surgery by appealing to the eye as well as to the understanding of the student, and by familiarizing him with that most useful department of anatomy which immediately relates to surgical operations, will also be found, it is hoped, not entirely useless as a work of reference to those already engaged in practice.

It has been the object of the translators to Americanize the language of the work to as great an extent as possible, making use of the terms in ordinary use in this country by teachers of anatomy and surgery, in order that the American student may not be annoyed by meeting with foreign modes of expression with which he is not familiar, and which, in their opinion, it is rarely desirable to introduce into common use. This almost invariable peculiarity of French translations has heretofore interfered both with their popularity and general utility; it has therefore been their endeavor to avoid it.

The additions, in the form of notes, which it has been thought proper to append to the original text, will not, it is hoped, be found to detract from its value.

New-York, October, 1851.

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Pl. I.

Fig. 3.



Fig. 1.



Fig. 2.



Fig. 4.

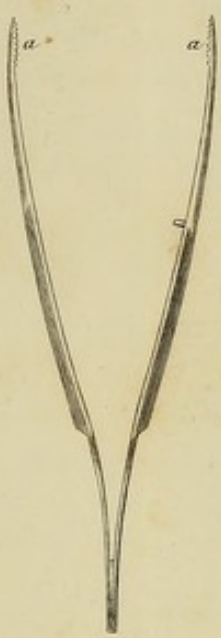


Fig. 5.

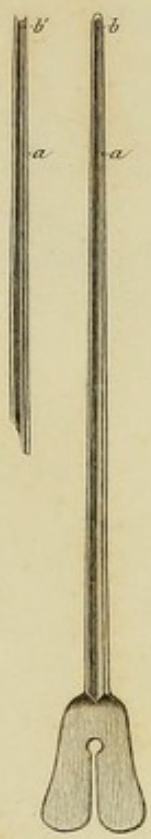


Fig. 6.

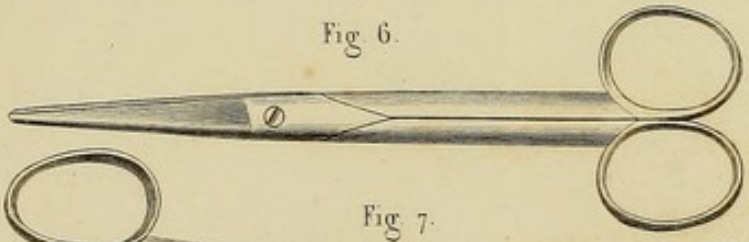


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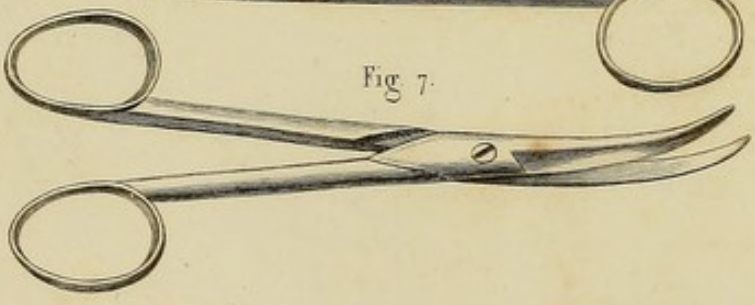


Plate I.

INSTRUMENTS REQUIRED FOR MAKING INCISIONS.

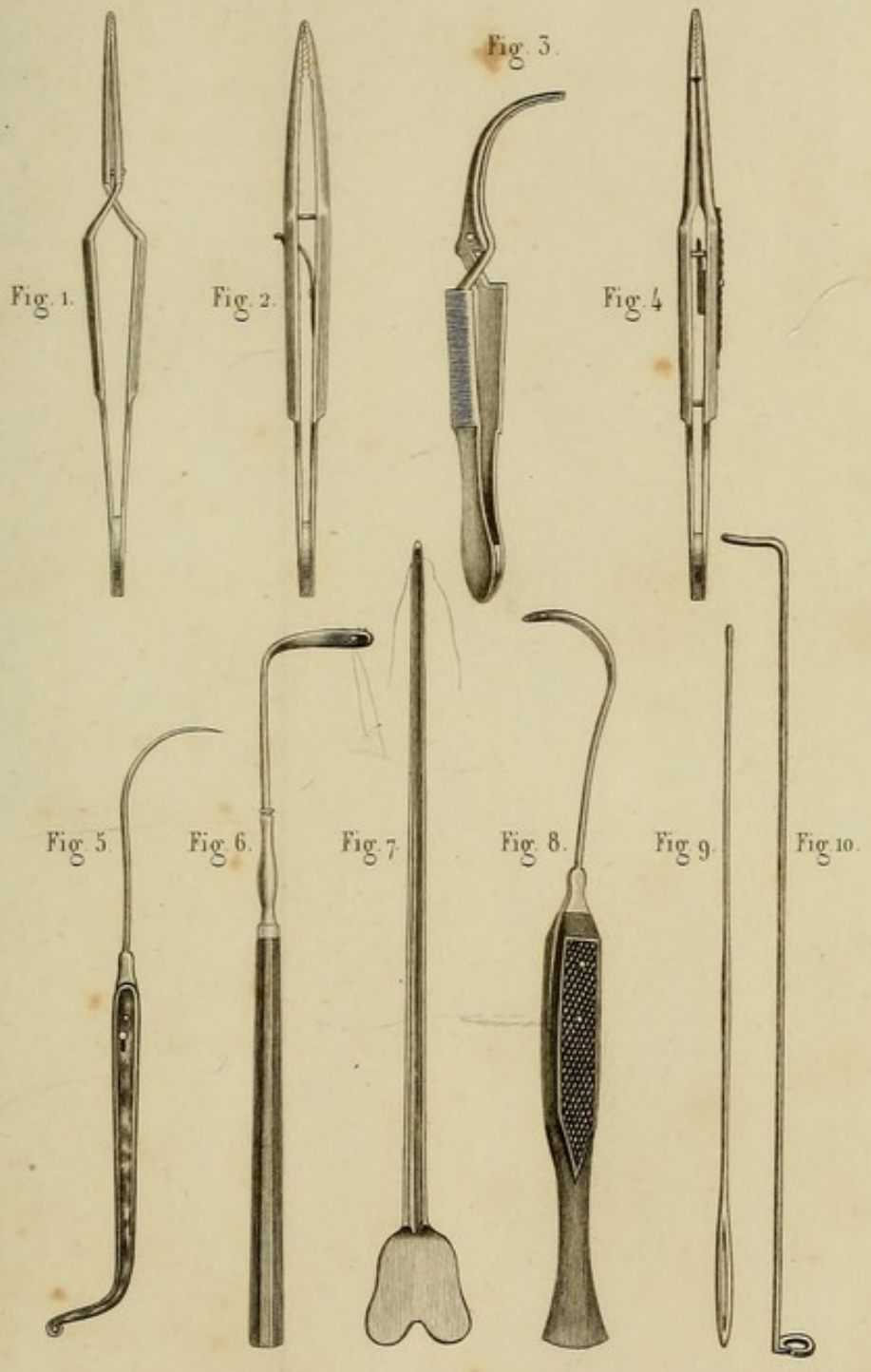
Fig. 1. Straight bistoury.
Fig. 2. Convex bistoury.
Fig. 3. Probe-pointed bistoury.
aaa back of the bistoury.
bbb edge of the bistoury.
ccc joint of the handle and blade.
ddd end of the handle.
Fig. 4. Ordinary dissecting forceps.
aa jaws of the forceps.
Fig. 5. Director.
a groove of the director.
b probe-like end of the director.
b′ extremity of a director in which the groove is continuous to the end.
Fig. 6. Straight scissors.
Fig. 7. Scissors curved on their cutting edges.

Plate II.

INSTRUMENTS REQUIRED FOR LIGATURE OF ARTERIES.

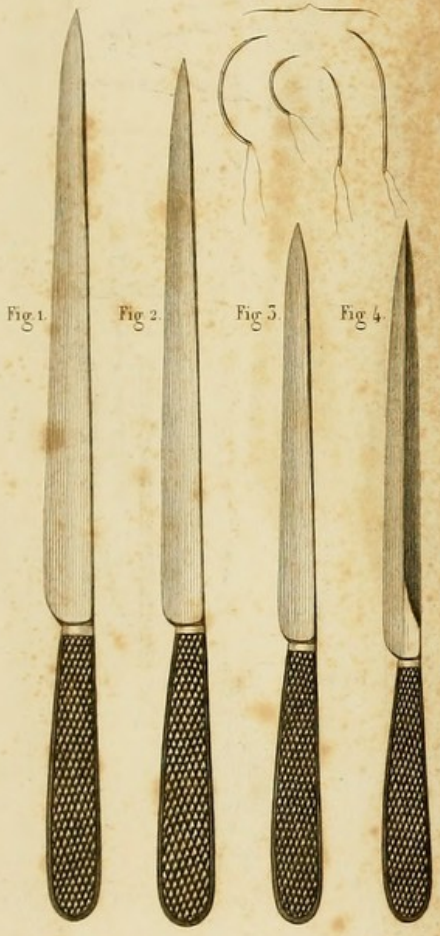
Fig. 1. Charrière's forceps for continued pressure.
Fig. 2. Graefe's spring artery forceps.
Fig. 3. Charrière's curved forceps for continued pressure.
Fig. 4. Amussat's torsion forceps.
Fig. 5. Tenaculum.
Fig. 6. Deschamps' artery needle.
Fig. 7. Director, with an eye in its extremity.
Fig. 8. Cooper's artery needle.
Fig. 9. Eyed probe.
Fig. 10. Sottot's knot-tightener.

PI. II.

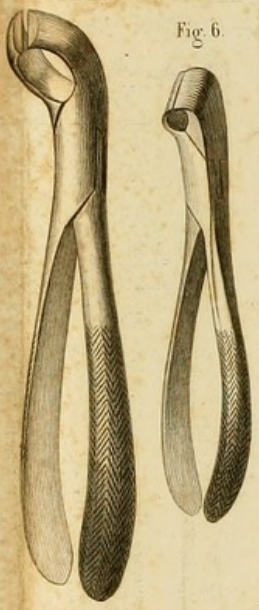


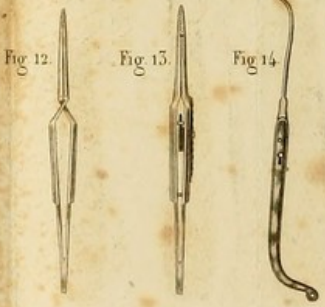
MODÈLES CHARRIÈRE.

PL. III.

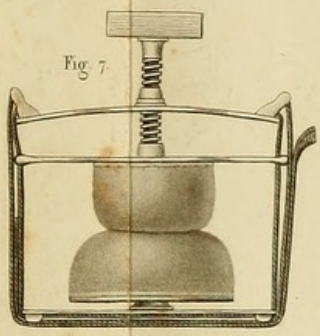


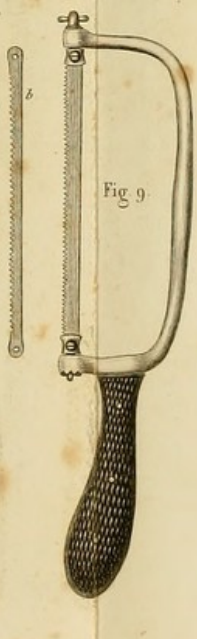




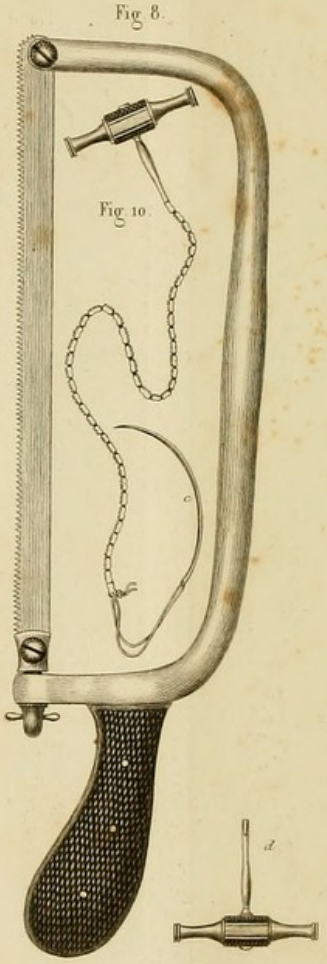


PL. IV.









MODELES CHARRIÈRE.

Plates III. & IV.

INSTRUMENTS REQUIRED FOR AMPUTATIONS.

Figs. 1, 2, 3. Amputating knives of different sizes.
Fig. 4. Interosseous knife, or catlin.
Figs. 5 and 6. Bone forceps.
Fig. 7. Charrière's tourniquet.
Fig. 8. Ordinary amputating saw.
a extra blade.
Fig. 9. Small amputating saw.
b extra blade.
Fig. 10. Chain saw.
c needle to conduct it.
d handle to be attached after the introduction of the saw.
Fig. 11. Suture needles.
Fig. 12. Charrière's forceps for continued pressure.
Fig. 13. Amussat's torsion forceps.
Fig. 14. Tenaculum.

Plates V. & VI.

INSTRUMENTS FOR EXSECTION OF BONES.

Fig. 1. Hey's saw.

Fig. 2. Knife-shaped saw.

Fig. 3. Small semicircular saw.—*a*, surface for a point of support to the index finger of the hand, holding the instrument, when it is desired to employ force with precision of motion.

Fig. 4. Larrey's straight saw.

Fig. 5. Martin's saw.—This consists of a rod, *a b*, with a circular saw at its extremity, *c*. A rotary motion is given to the rod, *a b*, and to the saw at its extremity, by another rod, *d e*, which is connected with the first by a universal joint, *f*. This arrangement allows the saw to move freely at any angle which the two rods may form with each other. The extremity, *h*, of the rod, *d e*, fits into the shaft of a trepan (fig. 5, *bis*) which is moved by an assistant, whilst the operator, holding the handle, *i*, which is traversed by the rod, *a b*, directs the action of the saw and graduates its force, using more or less pressure, as may be required. Saws of different diameters, *j*, or shaped like a mushroom, *k*, may be fitted to the rod, *a b*, according to circumstances.

Fig. 6. Charrière's rowel saw.—A crank, *a*, moves the wheel, *b*, the teeth of which, interlocking with those of the wheels, *c d e*, transmit a rotary motion to the saw, *f*. By means of this instrument, which is solid, firm, and of easy application, we can operate on bones which are very deeply seated. Saws of different diameters can be adapted to it.

Fig. 7. Dupuytren's perforator.—An instrument used for breaking up deeply seated *sequestra*, when they cannot be withdrawn whole on account of the narrowness of the external opening. Two serrated jaws, *aa*, which can be opened and closed at will, grasp the bony fragment, which is then acted upon by a central drill, put in motion by a bow, the string of which encircles the grooved wheel, *c*.

Fig. 8. Liston's bone forceps, used for dividing small bones at a single cut.

Fig. 9. Strong forceps, for holding steadily a portion of bone whilst being sawn.

Fig. 10. Forceps for the extraction of *sequestra*.

Figs. 11 and 12. Chisel and gouge.

Fig. 13. Leaden mallet.

Fig. 14. Rasp.

Fig. 15. Olive-shaped cautery-iron, in its handle.

Fig. 16. Hatchet-shaped cautery-iron.

Fig. 17. Nummular cautery.

PL. V.

Fig 1.



Fig 2.



Fig 5.

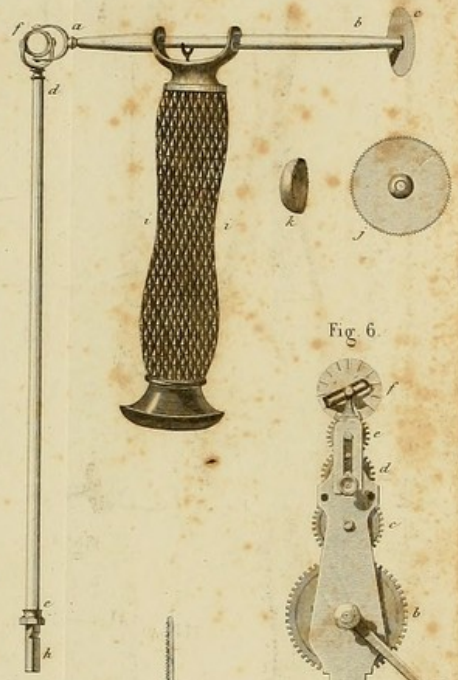


Fig 5 bis

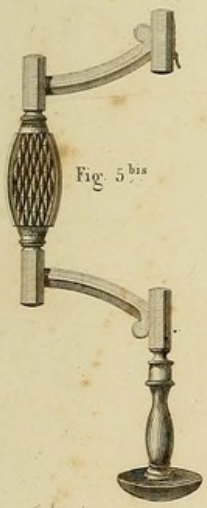


Fig 3.

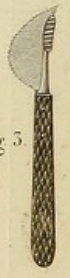


Fig 4.



Fig 6.



Fig 7.



Fig 8.

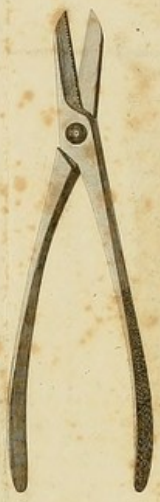


Fig 13.



Fig 11.



Fig 12.



Fig 14.



Fig 15.



Fig 16.

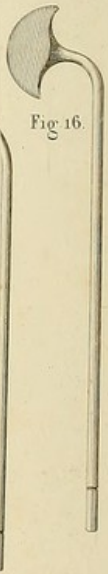


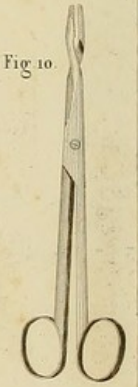
Fig 17.



Fig 9.



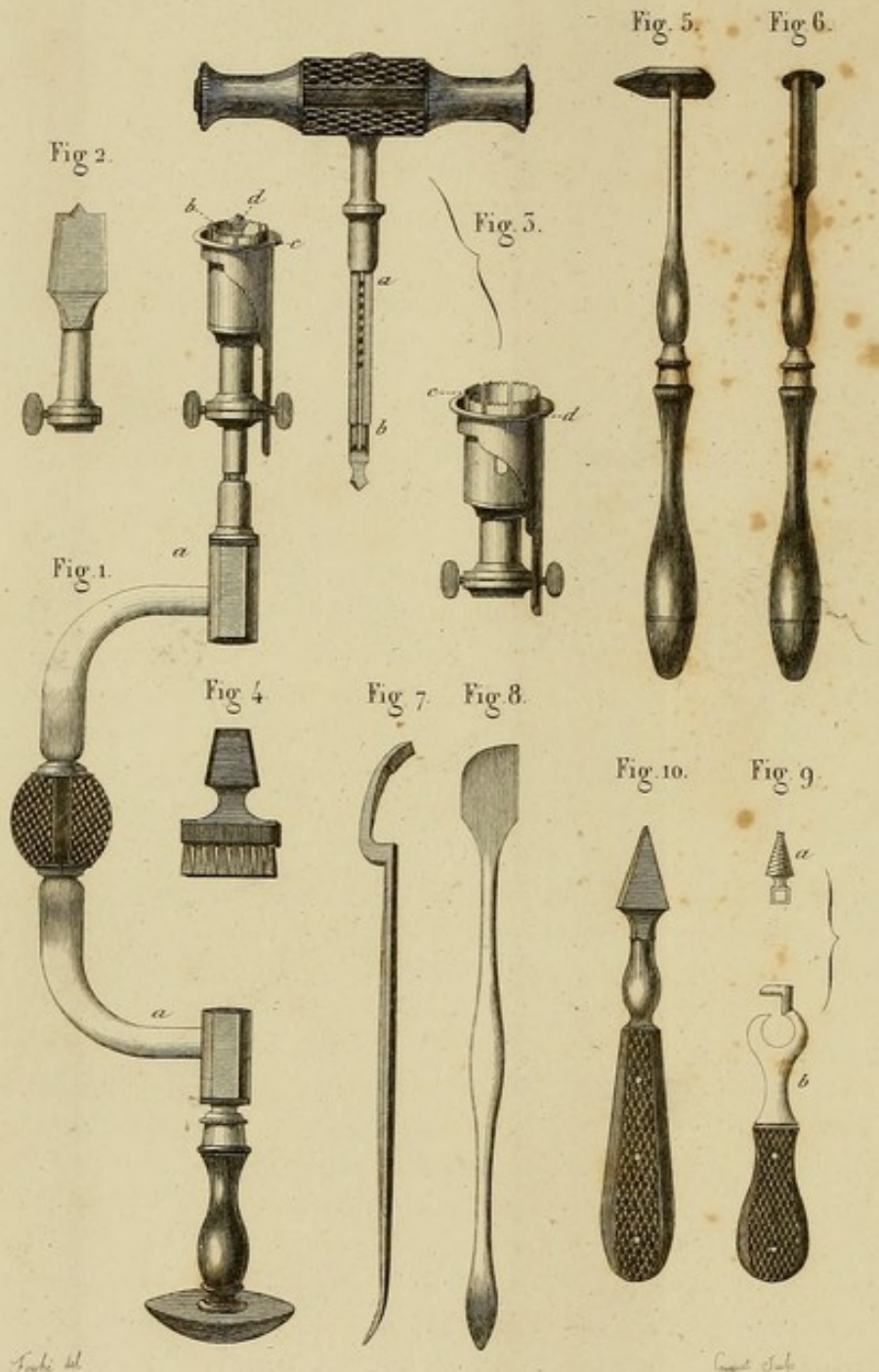
Fig 10.



PL. VI.

MODÈLES CHARRIÈRE

PI. VII.



MODÈLES CHARRIÈRE.

Plate VII.

TREPHINING INSTRUMENTS.

Fig. 1. *aa*, Shaft of the trepan surmounted by its crown, *b*; *c*, sliding guard for the purpose of limiting the depth to which the crown should penetrate; *d*, pyramidal extremity of the shaft supporting the crown, which serves as a perforator.

Fig. 2. Exfoliator.

Fig. 3. Hand trephine; *a b*, shaft and perforator; *c*, crown; *d*, sliding guard.

Fig. 4. Brush for cleaning the crown of the trephine.

Fig. 5. Raspatory, with five edges.

Fig. 6. Lenticular knife.

Fig. 7. Double elevator.

Fig. 8. Elevator and raspatory.

Fig. 9. Conical screw *a*, for the purpose of extracting a fragment of bone by the aid of its handle, *b*.

Fig. 10. Perforator, in a handle.

Plate VIII.

EYE INSTRUMENTS.

Fig. 1. Adams' forceps, modified by Charrière.

Fig. 2. Desmarres' ring-forceps for holding the upper eyelid steadily, during the removal of cysts and tumors which require a tedious and minute dissection.

Fig. 3. Desmarres' forceps with bifurcated extremities, for holding soft parts steadily for the passage of the suture needle.

Fig. 4. Charrière's straight forceps for continuous pressure. Its branches being delicate and long, grasp and retain readily folds of skin in operating.

Fig. 5. Another variety of forceps for continued pressure. Its blades, curved and notched externally, answer the double purpose of a stylet on which to introduce a canula into the lachyrmal duct, and also for its extraction.

Fig. 6. Forceps for grasping the free borders of the eyelids.

Fig. 7. Bistoury for opening lachrymal tumors, the lachrymal sac, and nasal duct.

Fig. 8. Gensoul's catheters for the lachrymal passages.

Fig. 9. Silver probes for the *puncta lacrymalia*.—Méjean's probe.

Fig. 10. Caustic holder, free, and in its canula, for the cauterisation of the lachyrmal sac.

Fig. 11. Anel's syringe; *a* and *b*, additional terminal tubes.

Fig. 12. Laugier's trocar, for perforating the maxillary sinus.

Fig. 13. *a*, Dupuytren's canula; *b* and *c*, Scarpa's leaden styles; *d*, Charrière's stylet of prepared ivory.

M. Charrière renders ivory soft by Hydrochloric Acid, and manufactures stylets of the material thus prepared, which possess the property of swelling when in contact with moist substances, and thus they effect the dilatation of the nasal duct.

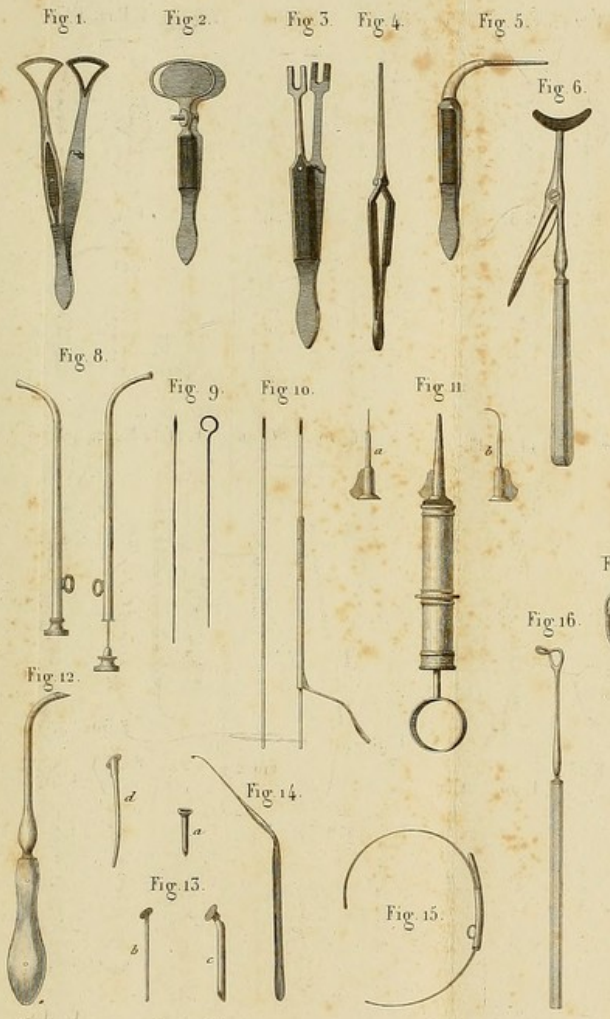
Fig. 14. Cloquet's hooked stylet for extracting canulas from the nasal duct.

Fig. 15. Desault's canula, with its probe-pointed stylet.

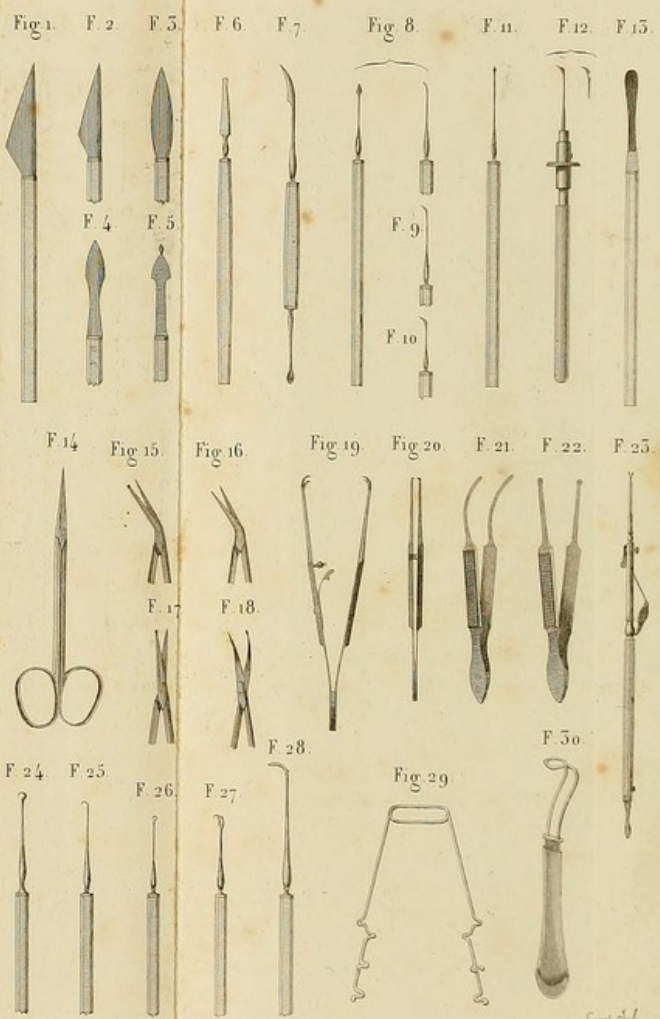
Fig. 16. Pomperat's instrument for elevating the upper eyelid.

Fig. 17. Luzardi's speculum.

PI. VIII.



PI. IX



MODÈLES CHARRIÈRE

Plate IX.

Fig. 1. Beer's cornea knife.
Fig. 2. Richter's cornea knife.
Fig. 3. Wenzel's cornea knife.
Fig. 4. Beer's lancet-shaped cornea knife.
Fig. 5. Furnari's cornea knife.
Fig. 6. Desmarres' knife for enlarging incisions of the cornea.
Fig. 7. Cheselden's sickle-shaped knife, modified by Boyer. At the other end of the instrument is a *curette*, *a*.
Fig. 8. Dupuytren's needle.
Fig. 9. Scarpa's needle.
Fig. 10. Walter's needle for keratonyxis.
Fig. 11. A very delicate needle.
Fig. 12. Luzardi's hooked needle.
Fig. 13. Velpeau's opthalmostat.
Fig. 14, 15, 16, 17, and 18. Delicate scissors for artificial pupil. Some are curved on their edges, with the extremity of one blade probe-pointed; others are curved flat-wise.
Fig. 19. Hooked forceps.
Fig. 20. Eye forceps.
Fig. 21. Forceps with curved blades.
Fig. 22. Maunoir's forceps for artificial pupil.
Fig. 23. Charrière's forceps. At its other end is a small sliding lancet which can be sheathed in the handle of the instrument.
Fig. 24 and 25. Hooks, sharp-pointed.
Fig. 26. Beer's hook.
Fig. 27. Double-hook, sharp-pointed.
Fig. 28. Blunt hook.
Fig. 29. Eye speculum.
Fig. 30. Gellies' instrument for elevating the upper eyelid.

Plate X.

INSTRUMENTS FOR OPERATIONS ON THE EAR.

Fig. 1. Itard's speculum.
Fig. 2. Bonnafond's speculum.
Fig. 3. Fabrizi's forceps for the extraction of foreign bodies.
Fig. 4. Dupuytren's forceps for the removal of polypi.
Fig. 5. Curette for the extraction of foreign bodies.
Fig. 6. Deleau's speculum.
Fig. 7. Fabrizi's double catheter.
Fig. 8. Itard's catheter, for injection of the Eustachian tube.
Fig. 9. Blanchet's catheter.
Fig. 10. Blanchet's caustic holder.
Fig. 11. Deleau's flexible catheter and stylet.
Fig. 11 *bis*. Funnel shaped extremity of Deleau's catheter.
Fig. 12. Fabrizi's trepan for perforating the *membrana tympani*.
Fig. 13. Bonnafond's forceps for carrying lint.
Fig. 14. Bonnafond's instrument for perforating the *membrana tympani*.
Fig. 15. Belloc's instrument for arresting hæmorrhage from the nasal fossæ.
Fig. 16. Deleau's instrument for perforating the *membrana tympani*.
Fig. 17. Caoutchouc bottle with stop-cock and valve; for injections of air, or sulphuric ether.

Pl. X.

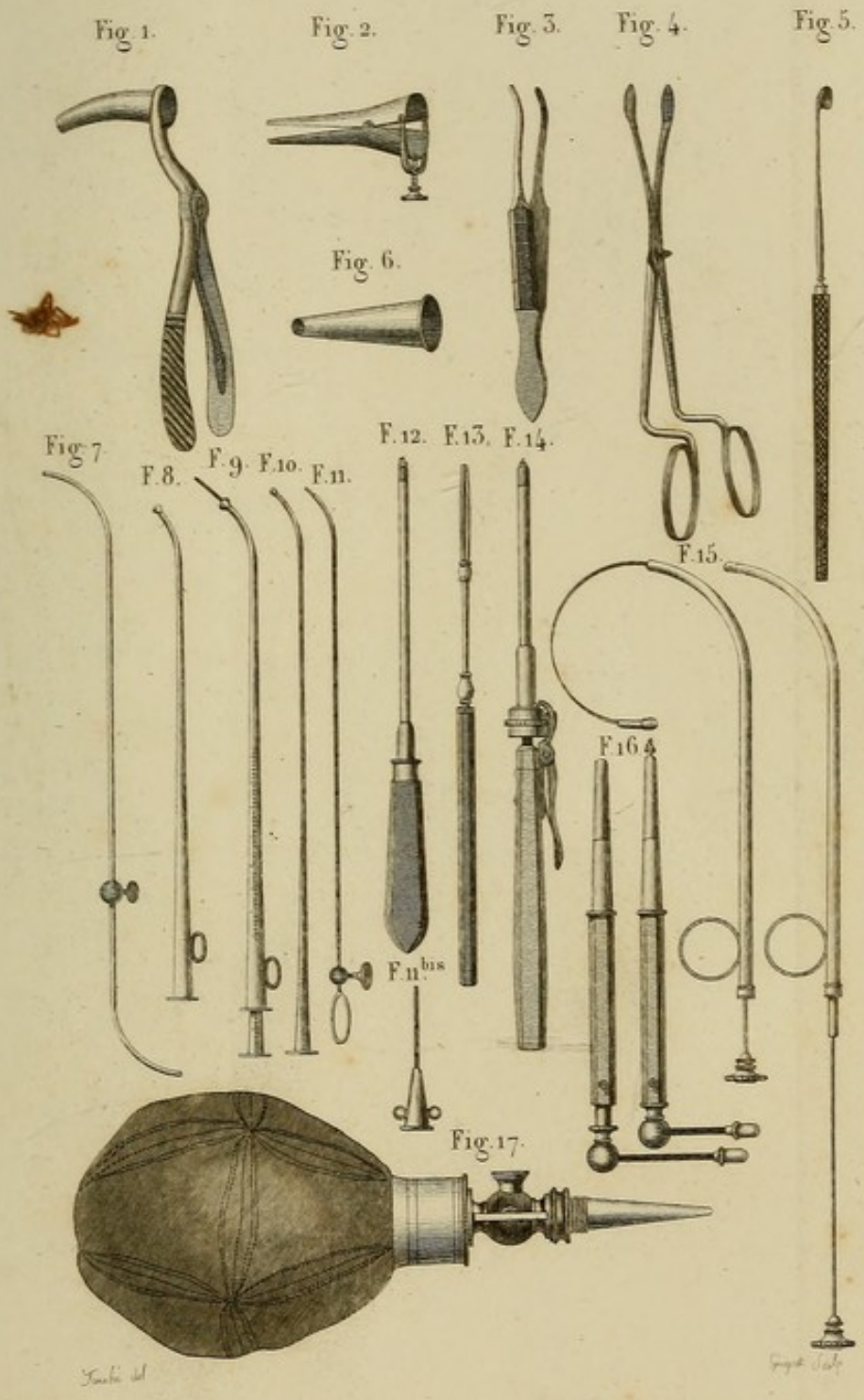

Fig. 1.
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Fig. 3.
Fig. 4.
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Fig. 6.
Fig. 7
F. 8.
F. 9.
F. 10.
F. 11.
F. 12.
F. 13.
F. 14.
F. 15.
F. 16.
F. 11. bis
Fig. 17.

Fig. 1.

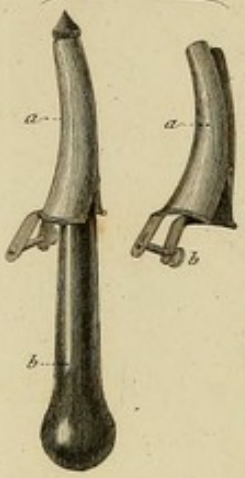


Fig. 2.



Fig. 3.



Fig. 4.



Fig. 10.

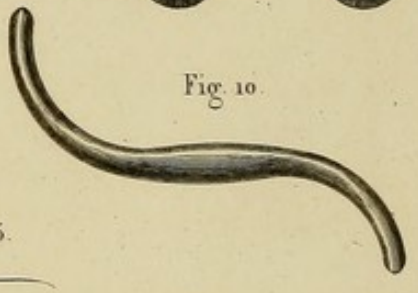


Fig. 5.

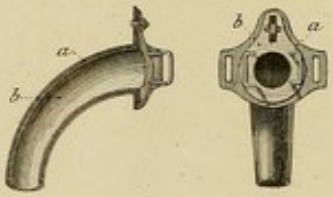


Fig. 6.



Fig. 11.

Fig. 12.

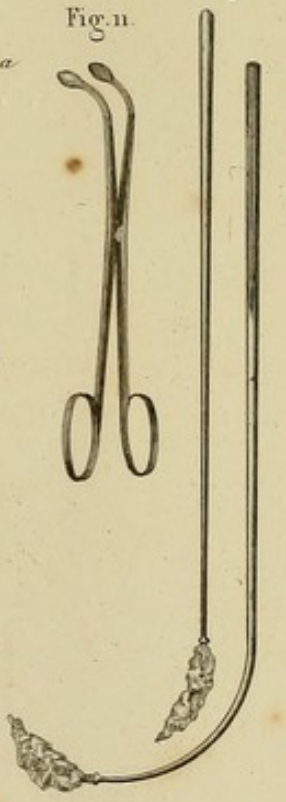


Fig. 7.

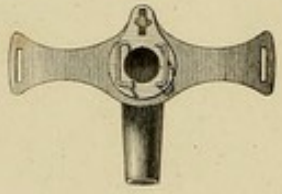


Fig. 8.



Fig. 9.

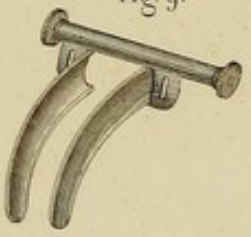


Fig. 13.

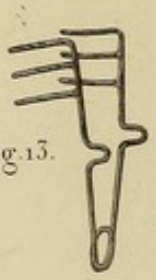


Plate XI.

INSTRUMENTS FOR LARYNGOTOMY AND TRACHEOTOMY.

Fig. 1. Moreau's bivalve canula *aa*, canulas; *b*, trocar.
Fig. 2. Bauchot's curved trocar, with its canula.
Fig. 3. Straight trocar and canula.
Fig. 4. Mop, or brush, for cleaning canulas, *in situ*.
Fig. 5. Borgelat's double canula, *a*, external canula; *b*, internal canula.
Fig. 6. Charrière's canula with a valve.
Fig. 7. Guersent's canula.
Fig. 8. Brettoneau's canula.
Fig. 9. Gendron's split canula.
Fig. 10. Guersent's whalebone handle for the introduction of canulas.
Fig. 11. Trosseau's dilating forceps.
Fig. 12. Sponges mounted upon whalebone handles for the purpose of cleansing canulas, *in situ*.
Fig. 13. Maslieurat-Lagemar's dilator.

Plate XII.

INSTRUMENTS FOR LIGATURE, ETC., OF NASAL POLYPI.

Fig. 1. Straight polypus forceps, with a movable pivot, and blades which can be taken apart.

Fig. 2. Curved polypus forceps.

Fig. 3. Felix Haten's ligature carrier; convex aspect, *a*, movable plate carrying the ligature; *b*, screw-rod acting upon the ligature and disengaging it by elevating the plate *a*; *c*, screw for separating, or bringing together, the two handles which open the instrument.

Fig. 3 *bis*. Concave aspect of same instrument, *a*, the movable plate and hooks, projected above the blades.

Fig. 4. Charrière's ligature carrier, *a*, a thumb-piece to act upon two movable rods by which the ligature passing through the groove at the top of the instrument can be disengaged, or retained at will.

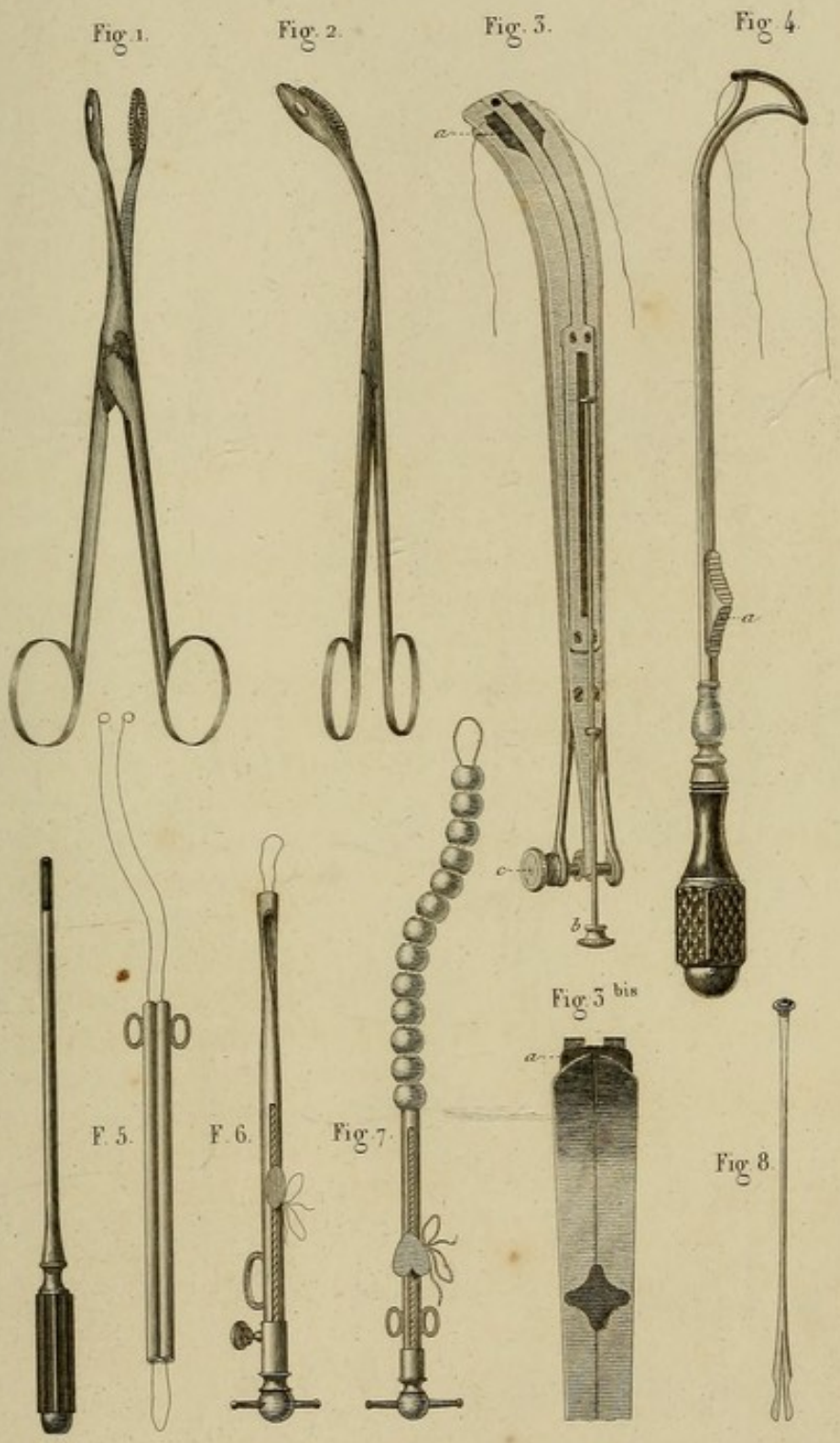
Fig. 5. Double canula.

Fig. 6. Græfe's knot-tyer modified by Dupuytren; the ligature is tightened by means of a double-screw contained within the canula.

Fig. 7. Mayor's beaded knot-tyer; the mechanism is the same. The beads allow the ligature to be applied in cavities, where a straight instrument could not be carried.

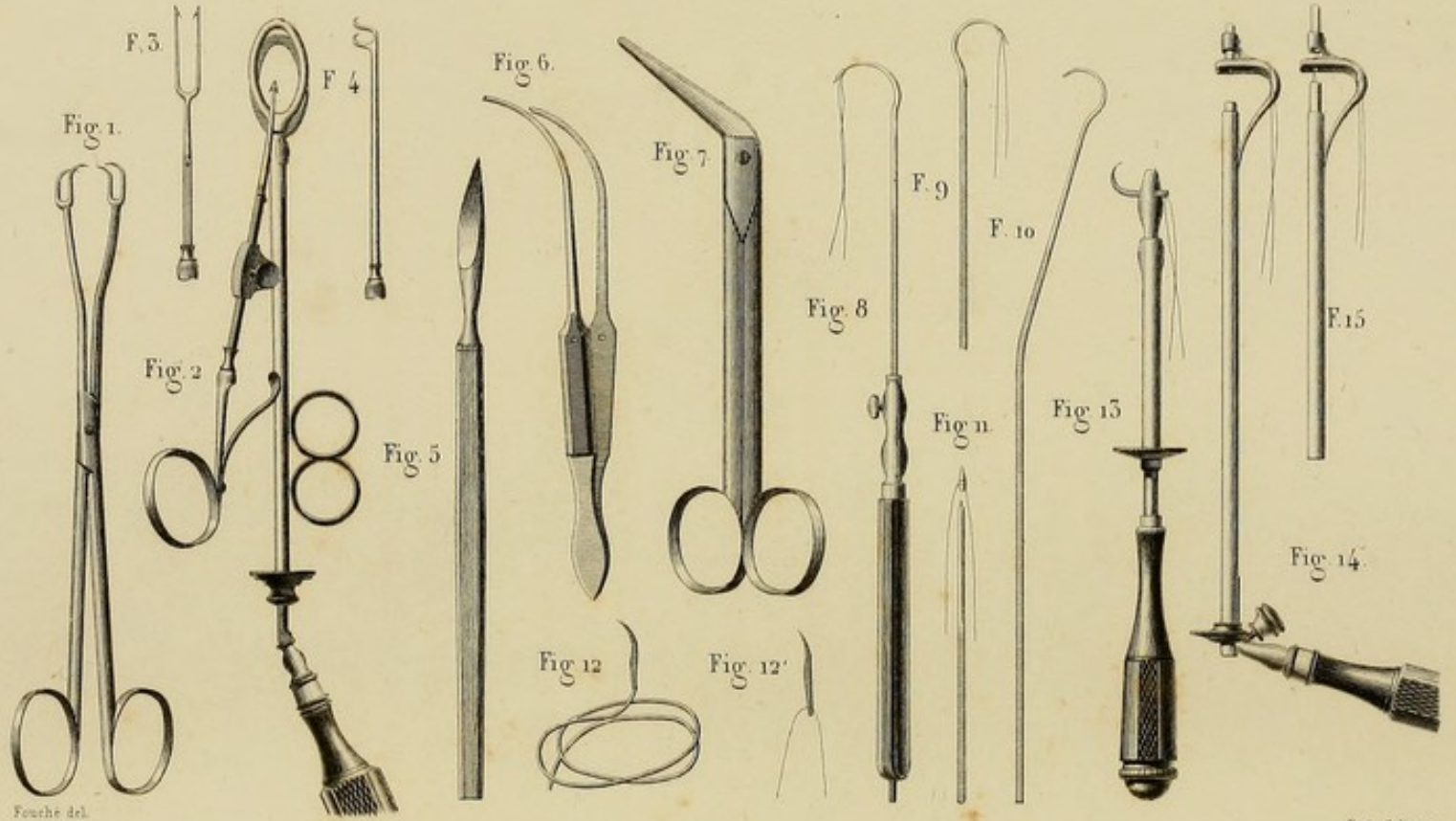
Fig. 8. Dessault's knot-tyer.

Pl. XII.



MODÈLES CHARRIÈRE.

Pl. XIII.



MODÈLES CHARRIÈRE

Plate XIII.

INSTRUMENTS REQUIRED IN OPERATIONS UPON THE TONSILS AND SOFT PALATE.

Fig. 1. Museux's forceps.
Fig. 2. Fahnestock's tonsil instrument, modified by Velpeau.
Fig. 3. Guersent's double barb, for transfixing the tonsil, which can be substituted at will for the single barb.
Fig. 4. The spiral hooks of Leroy d' Etiolles, for seizing the tonsil.
Fig. 5. Bistoury with long handle.
Fig. 6. Græfe's forceps.
Fig. 7. Roux's angular scissors for staphyloraphy.
Fig. 8, 9, 10, and 11. Bourgougnon's needle, and needle carrier, for carrying sutures through the soft palate.
Fig. 12. Dieffenbach's needle, with leaden wire as ligature.
Fig. 12 *bis*. Græfe's needle.
Fig. 13. Roux's needle, and needle holder.
Fig. 14 and 15. Depierris' instrument for carrying sutures through the soft palate.

Plate XIV.

INSTRUMENTS REQUIRED IN OPERATIONS UPON THE PHARYNX AND LARYNX.

Fig. 1. Œsophagus catheter, for administering nourishment artificially, and other purposes.

Fig. 2. Œsophagus forceps for extraction of foreign bodies.

Fig. 3. Fabret's catheter.

Fig. 4, 5, and 6. Blanche's catheter with a jointed stylet.

Fig. 7. Baillarger's catheter; *a*, stylet of iron wire; *b*, whalebone stylet.

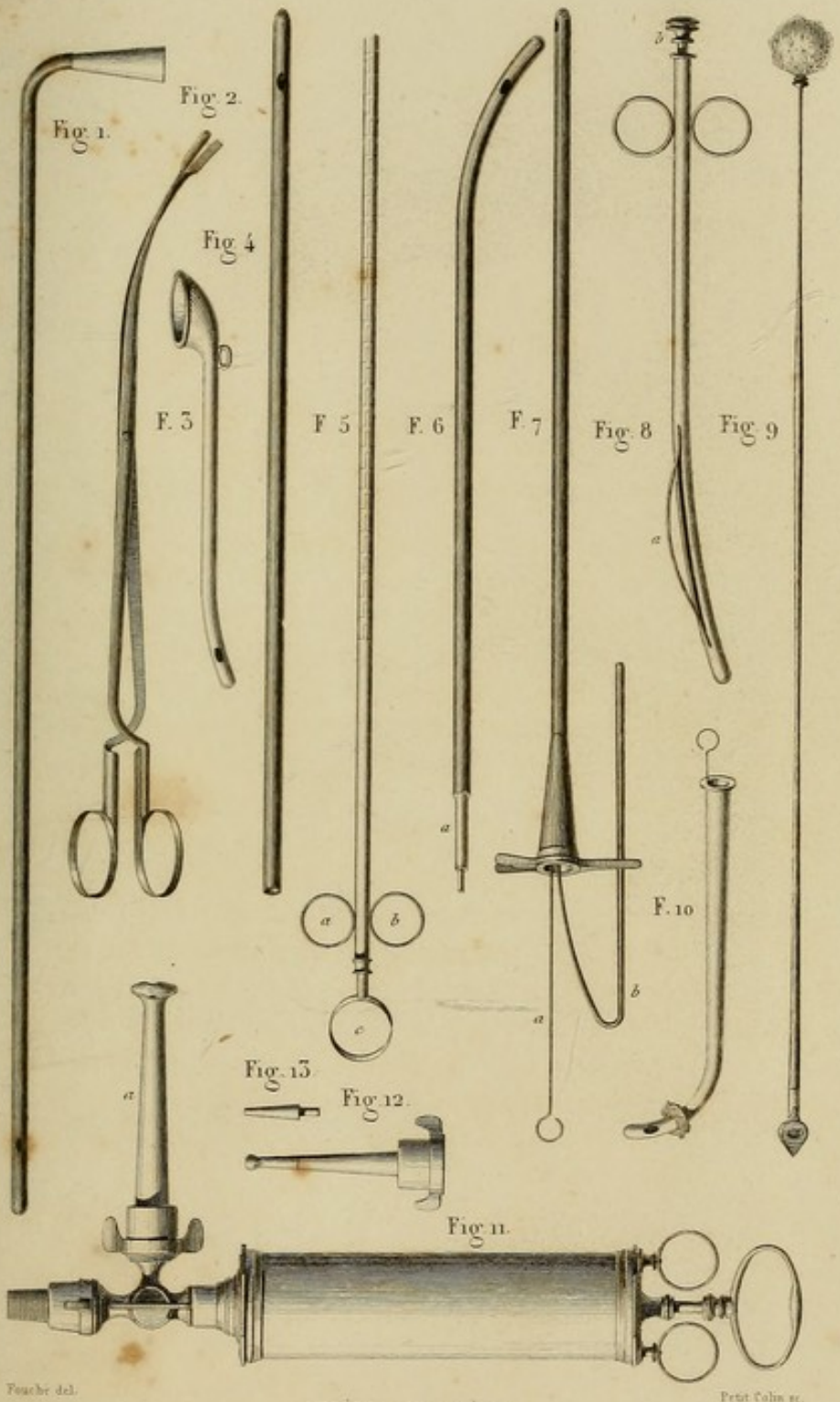
Fig. 8. Vacca's instrument for facilitating the incision of the œsophagus, modified.

Fig. 9. Double movable hook of Græfe and Dupuytren, for the removal of foreign bodies; it is attached to the free extremity of an ordinary sponge and whalebone probang.

Fig. 10. Chaussier's catheter for artificial respiration in newly-born infants.

Fig. 11. Charrière's syringe, with a stop-cock working in both directions, for the purpose of introducing fluids into the stomach, as well as of removing them, without detaching the syringe. *a*, tube to be immersed in the fluid; *b*, conical attachment for the œsophagal catheter.

Fig 12 and 13. Nozzles of the syringe, adapted to catheters of different calibre.



Fouche del. Petit Colin sc.

MODÈLES CHARRIÈRE.

Pl. XV.

Fig 1 et 2

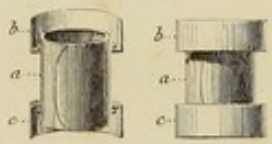


Fig 3.



Fig 4

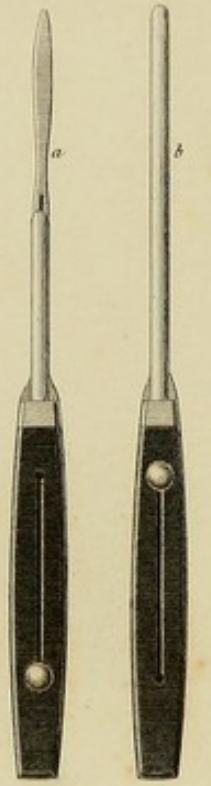


Fig 5.



Fig 6.

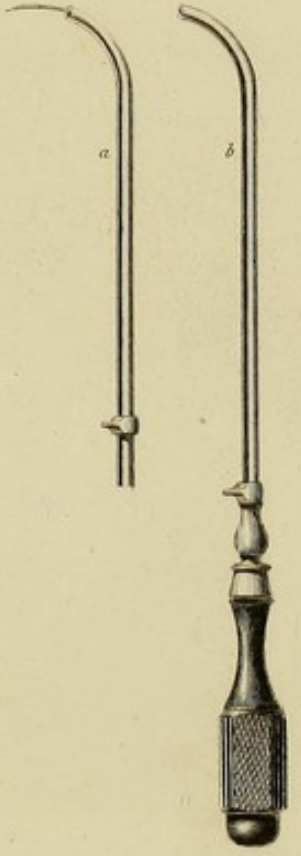
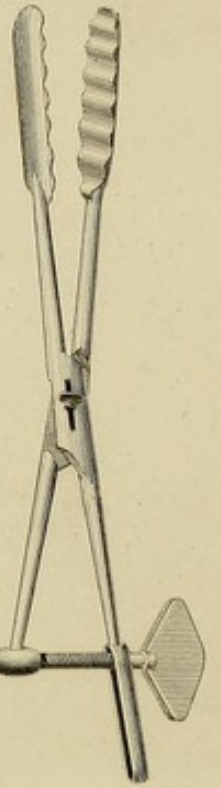


Fig 7.



Fig 8.



Fouché del.

Petit Colas sc.

MODELES CHARRIÈRE

Plate XV.

INSTRUMENTS FOR OPERATIONS UPON THE INTESTINES; WOUNDS OF THE INTESTINES; HERNIA; ARTIFICIAL ANUS.

Figs. 1 and 2. Denan's ferrule. Figure represents a section of the silver ferrules to show the arrangement of the steel ferrule *a*.

Fig. 3. A pair of pincers for grasping the steel ferrule *a* and lessening its diameter by pressure to facilitate its introduction into the two silver ferrules *b* and *c*.

Fig. 4. Blandin's bistoury, modified by Guerin for the radical cure of hernia; *a*, the blade disengaged from its sheath; *b*, the bistoury covered by the sheath.

Fig. 5. Boyer's needle-holder for inserting points of suture in abnormal anus.

Fig. 6. Gerdy's needle for the radical cure of hernia; *a*, the needle thrust out of its grooved sheath; *b*, the needle covered by the grooved sheath.

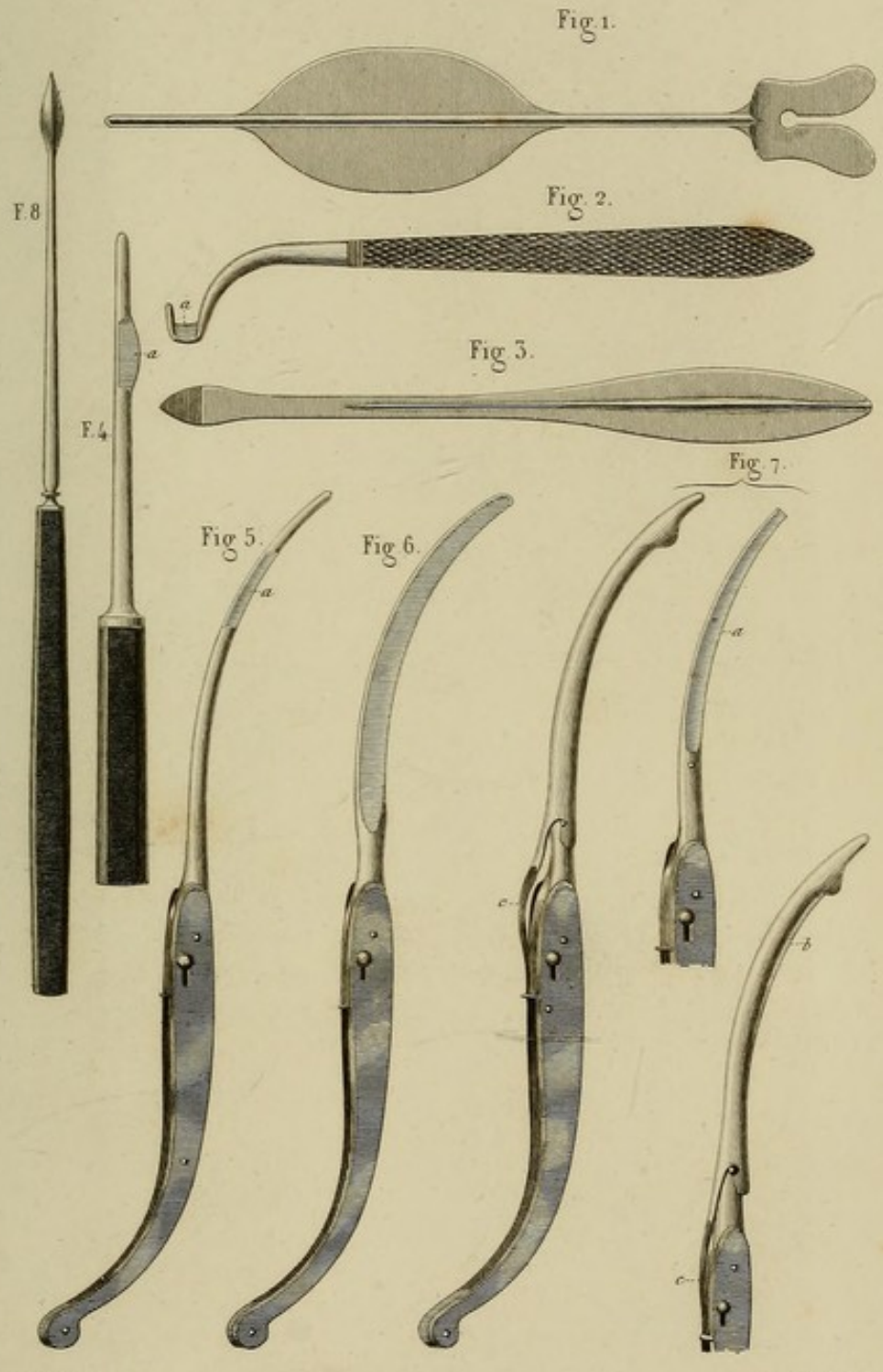
Fig. 7. Dupuytren's Enterotome.

Fig. 8. Blandin's Enterotome.

Plate XVI.

CONTINUATION OF INSTRUMENTS FOR OPERATIONS UPON THE INTESTINES, ETC.

Fig. 1. Boyer's director with lateral extensions.
Fig. 2. Thompson's bistoury; *a*, the cutting edge.
Fig. 3. Vidal de Cassis grooved spatula.
Fig. 4. Tesse's bistoury; *a*, the edge.
Fig. 5. Astley Cooper's bistoury; *a*, the edge.
Fig. 6. Pott's bistoury.
Fig. 7. Grimala's sheathed bistoury; *a*, the blade; *b*, the blade disengaged from the sheath by pressure upon the spring *c*.
Fig. 8. Velpeau's lance-shaped needle for the radical cure of hernia.



Fouché del. Petit Colin sc.

MODÈLES CHARRIÈRE

Fig 6.

Fig 7.

Fig 5.

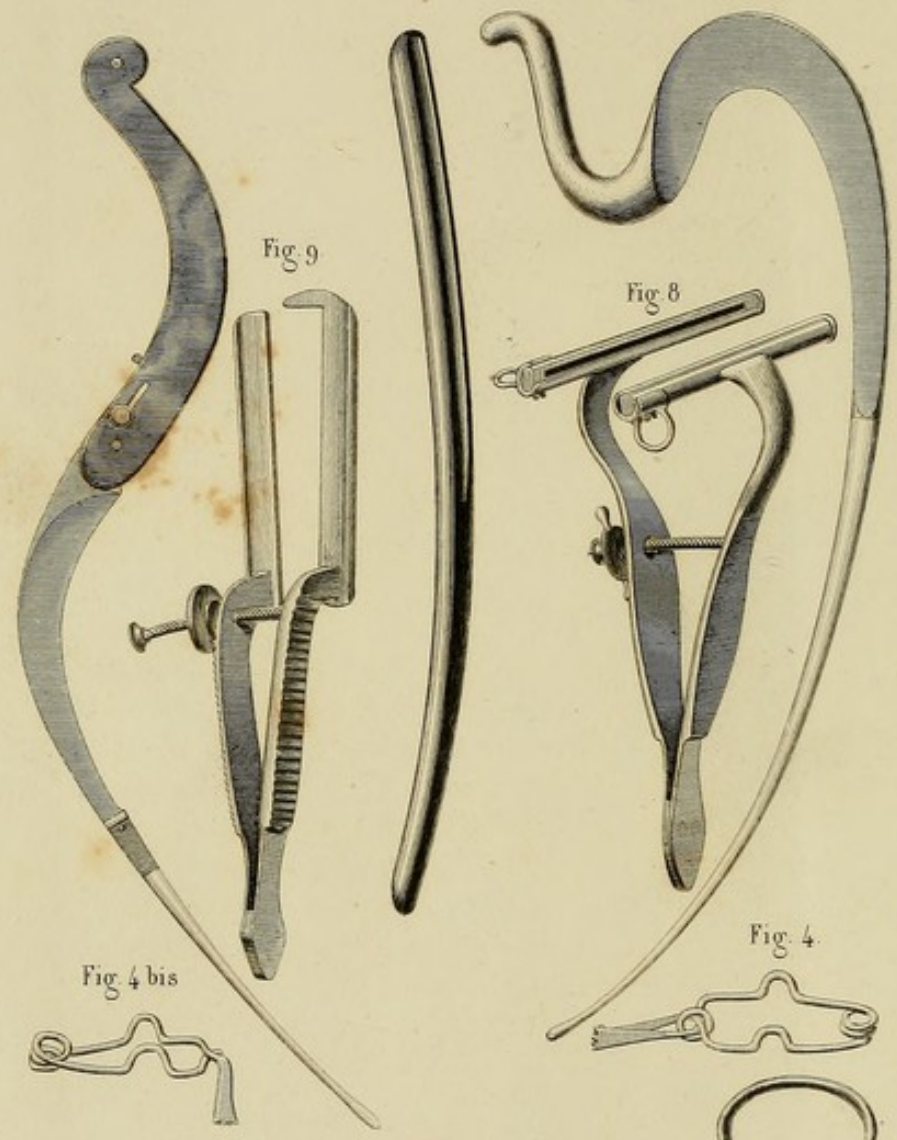


Fig 9.

Fig 8.

Fig 4 bis

Fig 4.

Fig 2.

Fig 3.

Fig 1.

Fouché del.

Petit Collin sc.

MODÈLES CHARRIÈRE

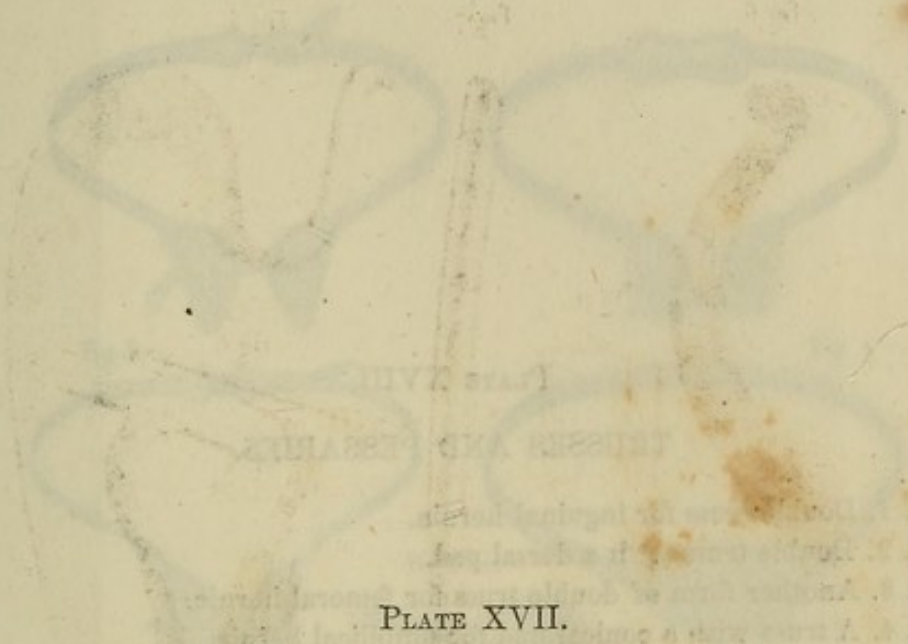


Plate XVII.

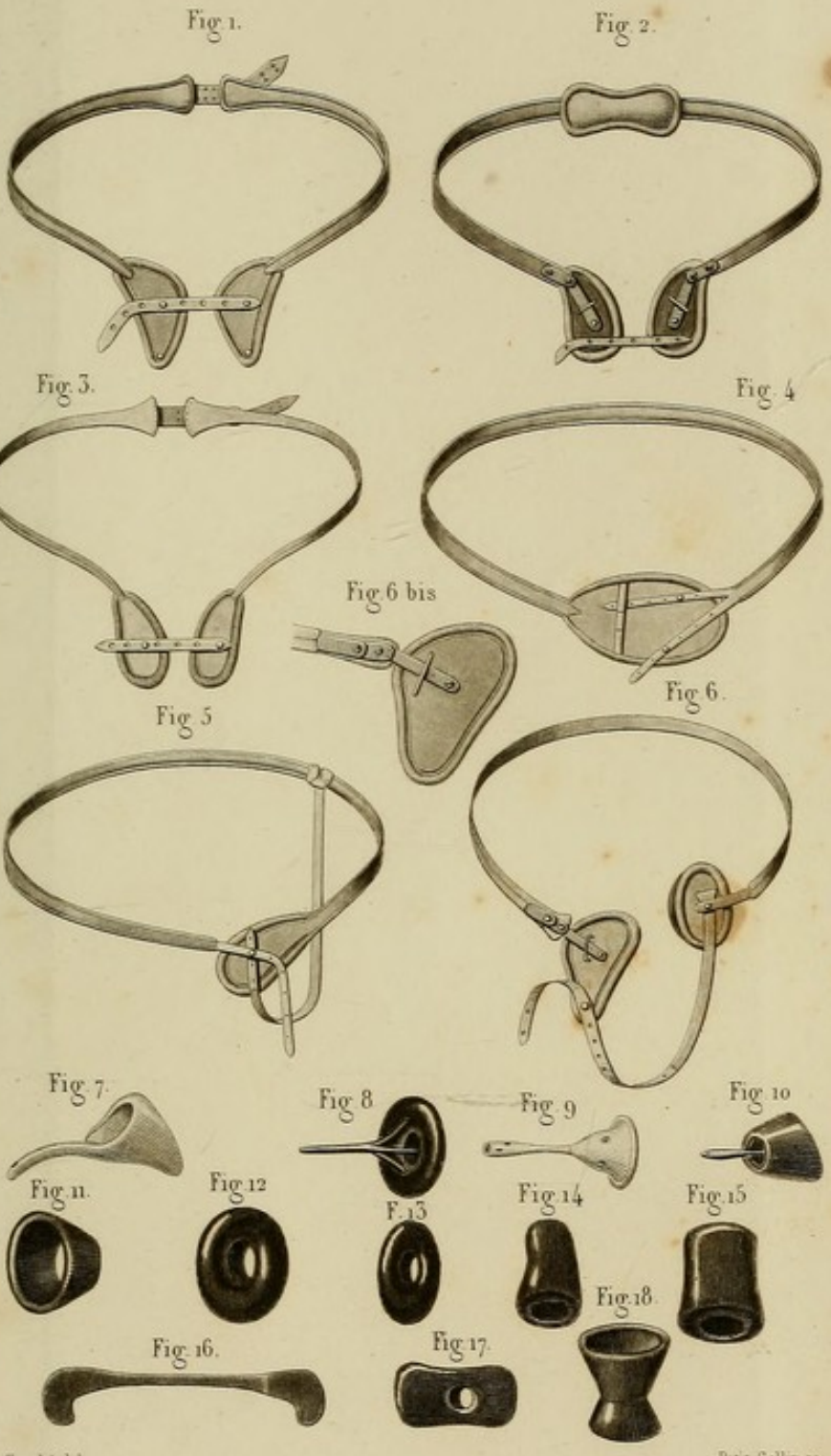
INSTRUMENTS FOR THE OPERATIONS OF PHYMOSIS, FISTULA IN ANO, AND HEMORRHOIDS.

Fig. 1. A lance-shaped needle for the operation of phymosis.
Fig. 2. Ricord's pincers for phymosis.
Fig. 3. Vidal's pincers for phymosis.
Fig. 4 and 4 bis. Vidal's small self-acting pincers.
Fig. 5. A bistoury for fistula in ano with a probe attached.
Fig. 6. Marx and Brechet's bistoury with a probe attached.
Fig. 7. Desault's wooden gorget for fistula in ano.
Fig. 8 and 9. Amussat's caustic-holding forceps and protecting forceps for operating upon hemorrhoids.

Plate XVIII.

TRUSSES AND PESSARIES.

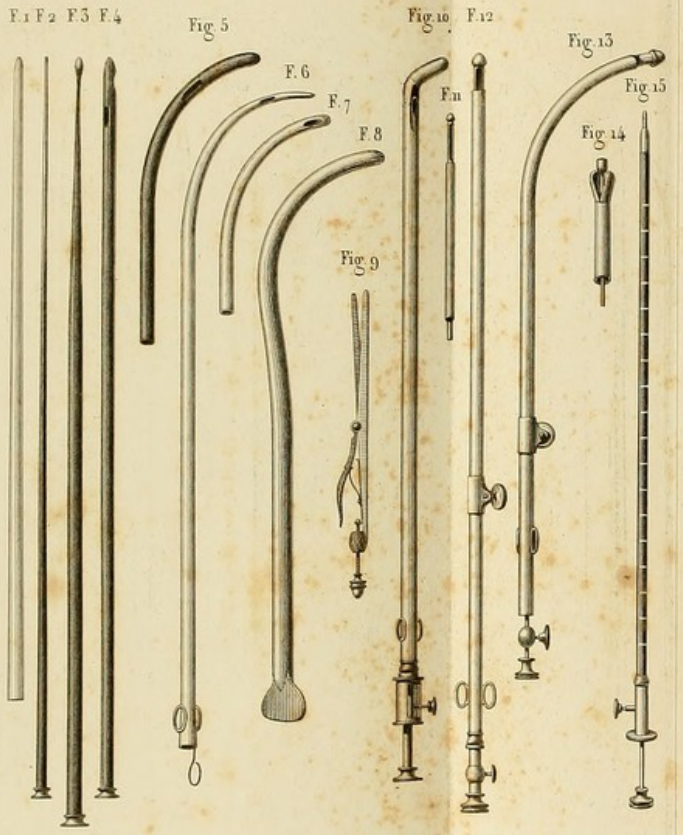
Fig. 1. Double truss for inguinal hernia.
Fig. 2. Double truss with a dorsal pad.
Fig. 3. Another form of double truss for femoral hernia.
Fig. 4. A truss with a conical pad for umbilical hernia.
Fig. 5. A simple truss.
Fig. 6. A simple truss from left to right.
Fig. 6. *bis*. A very strong inguinal pad.
Fig. 7. Hervez de Chegoin's pessary for anteversion of the uterus.
Fig. 8. Annular pessary with a stem and central perforation.
Fig. 9. An ivory pessary in the shape of the cup and ball toy.
Fig. 10. A funnel shaped pessary oblique and provided with a stem.
Fig. 11. A simple funnel-shaped pessary.
Fig. 12. A round funnel-shaped pessary with the central perforation.
Fig. 13. An oval funnel-shaped pessary with the central perforation.
Fig. 14. A pessary, shaped like the bung of a barrel.
Fig. 15. Jules Cloquet's pessary.
Fig. 16. Kilian's pessary.
Fig. 17. A figure of eight pessary.
Fig. 18. Malgaigne's hourglass pessary.



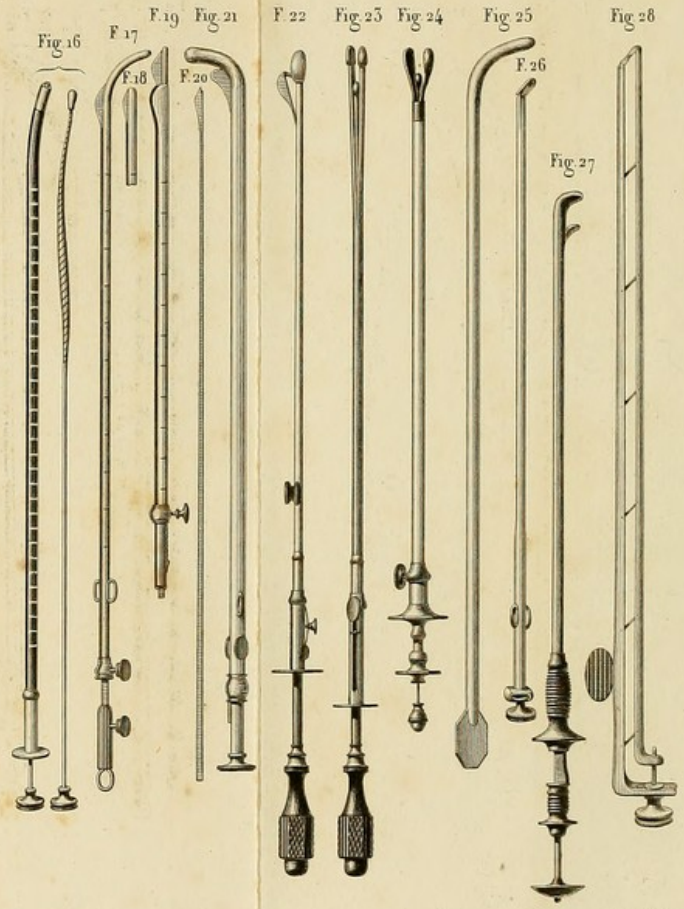
Fouché del. Petit Collin sc.

MODÈLES CHARRIÈRE

Pl. XIX.



Pl. XX.



Fouché del.

Prétcelin sc.

Plate XIX. and XX.

INSTRUMENTS FOR TREATING DISEASES OF THE URETHRA AND PROSTATE GLANDS.

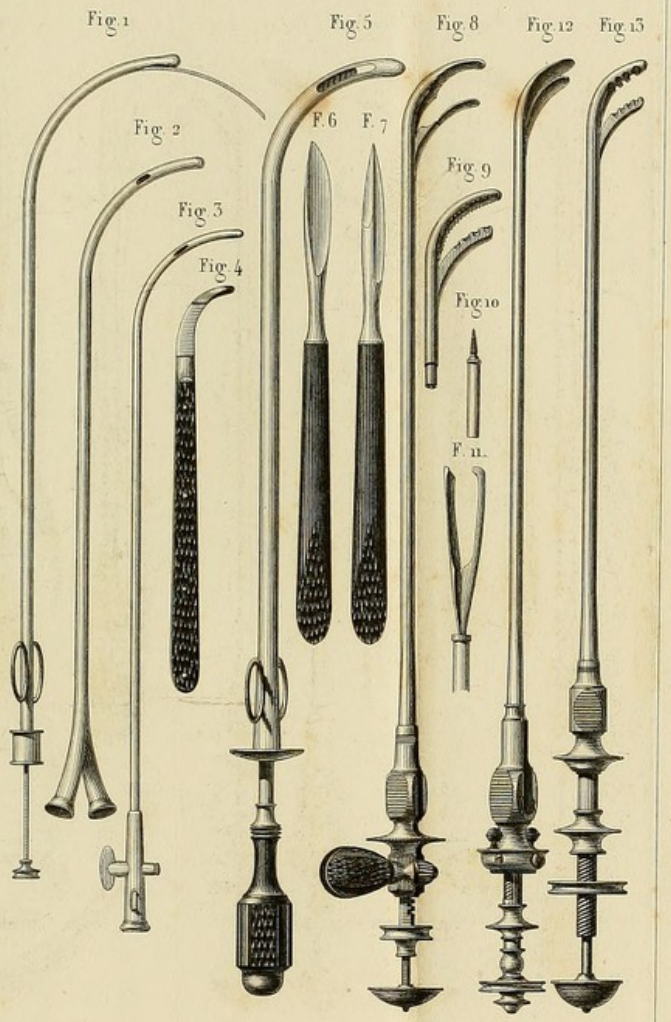
Fig. 1. A wax exploring bougie.
Fig. 2. A conical gum-elastic bougie.
Fig. 3. A conical gum-elastic bougie with an olive-shaped point.
Fig. 4. A straight gum-elastic catheter.
Fig. 5. A curved gum-elastic catheter.
Fig. 6. A conical silver catheter.
Fig. 7. A curved silver catheter.
Fig. 8. A pewter bougie.
Fig. 9. Civiale's instrument for incising the urethra.
Fig. 10. Mercier's instruments for applying caustic to the prostate gland.
Fig. 11. Lallemand's instrument for cauterising the urethra.
Fig. 12. Civiale's instrument for cauterising the urethra and prostate gland.
Fig. 13. Lallemand's instrument for cauterising the prostate gland for involuntary seminal emissions.
Fig. 14. Barré de Rouen's instrument for cauterising the urethra from before backward.
Fig. 15. Ducamp's instrument for cauterising the urethra from before backward.
Fig. 16. Leroy d'Etiolles instrument for cauterising the urethra from before backward.
Fig. 17. Ricord's curved scarificator.
Fig. 18. Ricord's straight scarificator.
Fig. 19. Begin and Robert's sheathed scarificator.
Fig. 20. An extra blade to a scarificator.
Fig. 21. Mercier prostatic scarificator.
Fig. 22. Civiale's urethral scarificator.
Fig. 23. Civiale's instrument for exploring strictures.
Fig. 24. Hunter's double branched forceps.
Fig. 25. Mercier's prostatic sound.
Fig. 26. Leroy d'Etiolles jointed curette.
Fig. 27. An instrument for crushing stones in the urethra.
Fig. 28. A straight urethral dilator.

Plate XXI.

INSTRUMENTS FOR THE OPERATIONS OF LITHOTRITY AND LITHOTOMY.

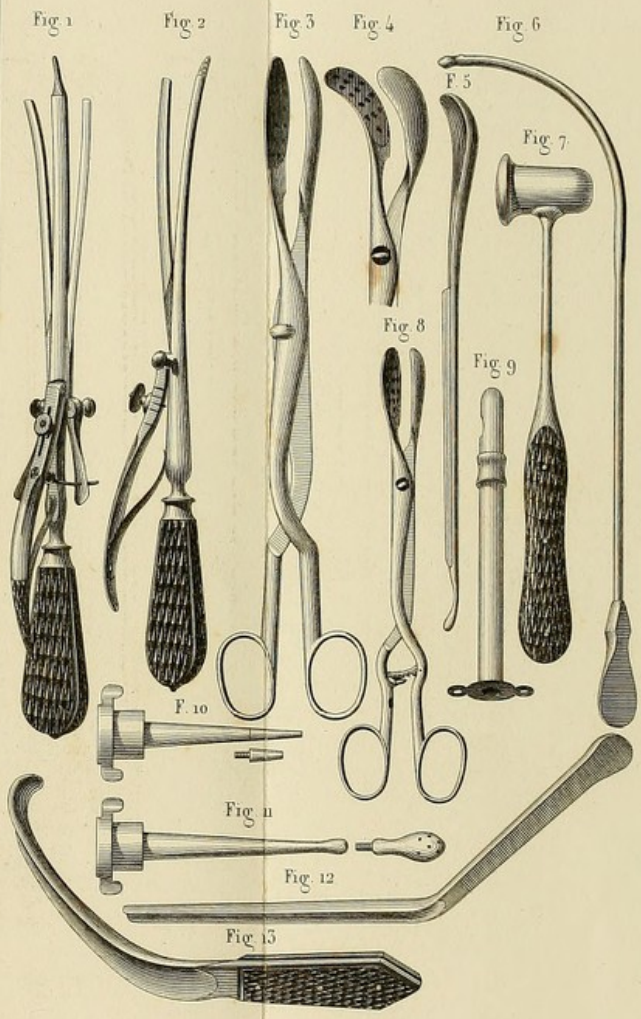
Fig. 1. Frère Côme's dart catheter, modified by Civiale.
Fig. 2. Jules Cloquet's metallic double catheter.
Fig. 3. A catheter with a stop-cock, with Pasquier's curve.
Fig. 4. Belmas' bistoury for incising fasciæ.
Fig. 5. Pasquier's evacuating catheter.
Fig. 6. A convex bistoury fastened firmly to its handle.
Fig. 7. A double-edged bistoury for perineal lithotomy, also fastened firmly to its handle.
Fig. 8. Mercier and Charrière's rack and pinion lithotrite, whose jaws are spoon-shaped, with fenestræ.
Fig. 9. Heurteloup's rack and pinion lithotrite, with fenestræ in the jaws.
Fig. 10. An instrument for extracting a bougie in the bladder.
Fig. 11. An instrument for extracting foreign bodies from the bladder.
Fig. 12. Amussat's, Civiale's and Charrière's severed lithotrite, with flat jaws.
Fig. 13. Segala's and Charrière's screw lithotrite, with open jaws.

Pl. XXI



Fouché del.

Pl. XXII



Petitcolin ac.

Plate XXII.

OTHER INSTRUMENTS FOR THE OPERATIONS OF LITHOTRITY AND LITHOTOMY.

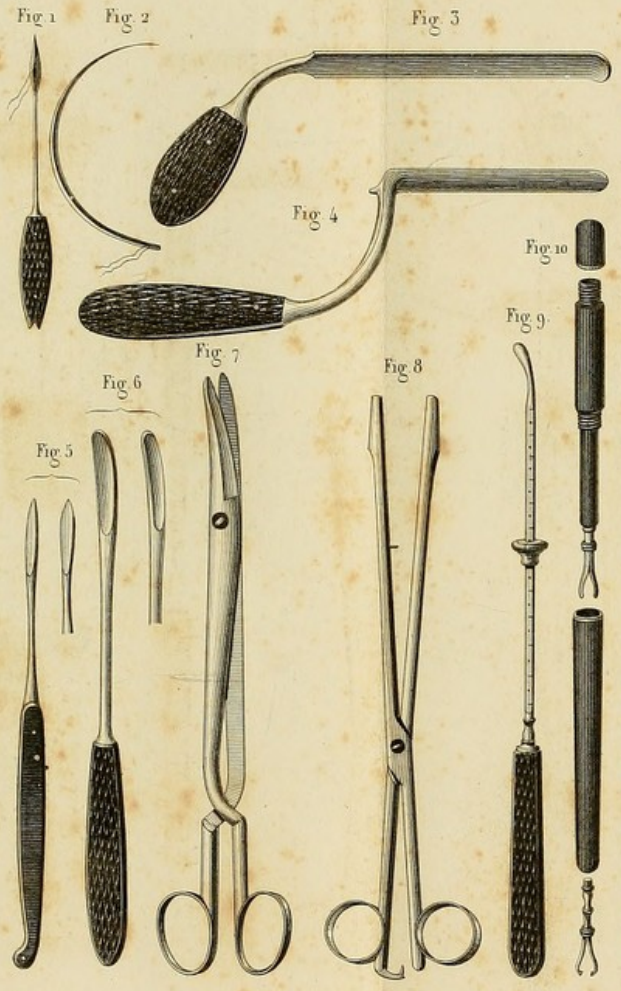
Fig. 1. Dupuytren's double lithotome, Charrière's model.
Fig. 2. Frère Côme's simple lithotome, modified by Charrière.
Fig. 3. Straight lithotomy forceps, whose branches cross and recross near the handles.
Fig. 4. Curved lithotomy forceps.
Fig. 5. A curette with a probe at one extremity, and a groove along which the forceps can be slid.
Fig. 6. A staff with the edges of the groove rounded.
Fig. 7. A hammer for striking the lithotrite when the calculus is broken by percussion.
Fig. 8. A pair of straight lithotomy forceps, whose handles cross and recross ,with a rack attached, which is both voluntary and self-acting, the branches being united and disjointed by a novel arrangement of the pivot. .
Fig. 9. Dupuytren's canula used in plugging the wound.
Fig. 10. A canula with three different sized tips, to be applied to Charrière's syringe (plate XIV, fig. 11, 12 and 13).
Fig. 11. A canula which can be used as a single jet, or to which an additional piece with numerous perforations can be attached for injecting the bladder.
Fig. 12. A blunt gorget which can be used as a guide for the forceps.
Fig. 13. Belmas' and Civiale's blunt gorget with a hook-like extremity.

Plate XXIII.

INSTRUMENTS FOR THE TREATMENT OF THE DISEASES OF FEMALES.

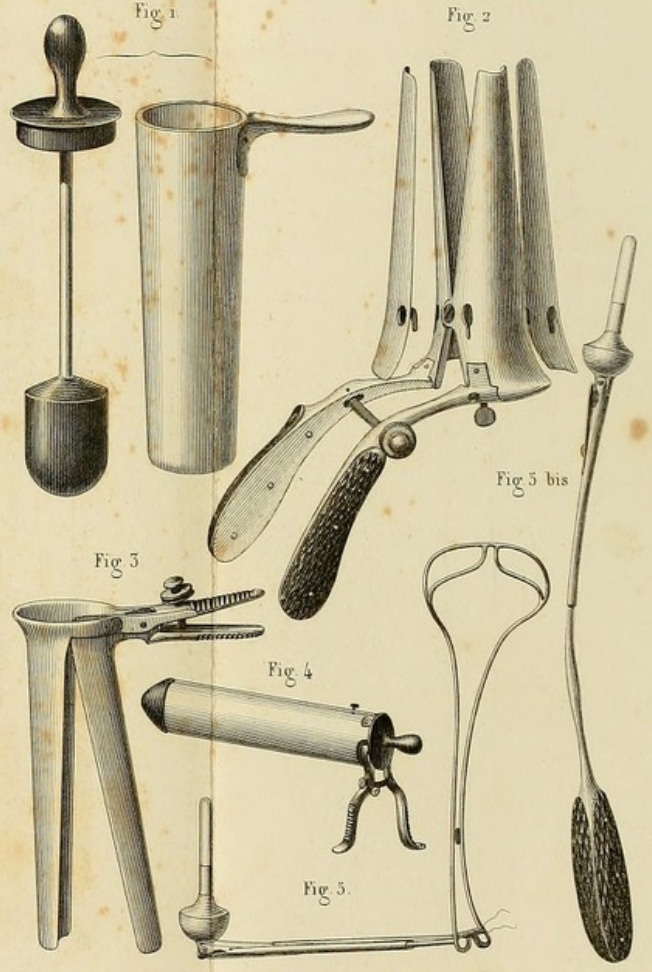
Fig. 1. Vidal (de Cassis) needle for suture of the perineum.
Fig. 2. Roux' needle for the same purpose.
Fig. 3. Jobert's flat blade for depressing the lateral walls of the vagina.
Fig. 4. A depressor with an elbowed valve for the posterior part of the vagina.
Fig. 5. Two convex sharp-pointed bistouries for paring off the edges of a fistula.
Fig. 6. Two knives, a right and left, for dividing the neck of the uterus.
Fig. 7. A pair of long scissors curved on their flat surface.
Fig. 8. Jules Cloquet's forceps for holding a ligature.
Fig. 9. An uterine sound, modified by Valleix.
Fig. 10. A long caustic-holder for three distinct purposes: 1st. a pair of forceps with two branches; 2d. a pair of forceps for holding the nitrate of silver; 3d. a reservoir caustic-holder (which is not shown in the plate).

Pl. XXIII



Fouche del.

Pl. XXIV



Petitcohn sc.

MODÈLES CHARRIÈRE.

Plate XXIV.

OTHER INSTRUMENTS FOR THE TREATMENT OF THE DISEASES OF FEMALES.

Fig. 1. Jobert's ivory speculum.
Fig. 2. Ricord and Charrière's speculum with four valves.
Fig. 3. Bennet's bivalve speculum.
Fig. 4. A speculum with three valves.
Fig. 5. Valleix' instrument for rectifying the position of the uterus.
Fig. 5, *bis*. the same instrument attached to a handle for the purpose of introducing it.

Plate XXV.

INSTRUMENTS FOR OBSTETRICAL OPERATIONS.

Fig. 1. Smellie's perforator with a protecting sheath.
Fig. 2. Van Huewel's pelvimeter.
Fig. 3. Baudelocque's pelvimeter.
Fig. 4. Dubois' scissors for cutting open the head, the branches being crossed and recrossed near the handles.
Fig. 5. A pair of forceps with a spring temper.
Fig. 6. Baudelocque's cephalotribe, with Depaul and Charrière's articulated rack.
Fig. 6. *bis.* The key of the cephalotribe for turning the rack.
Fig. 7. A pair of abortion forceps.
Fig. 8. Scholler's whalebone instrument for holding or changing the position of the umbilical cord.

Fig. 3.

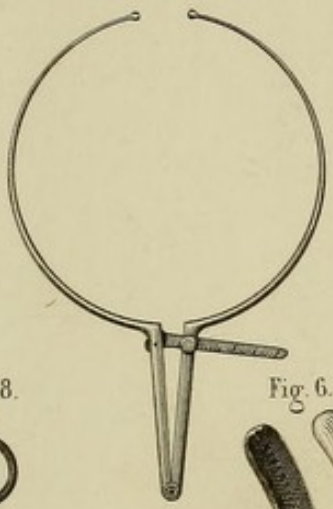


Fig. 2.

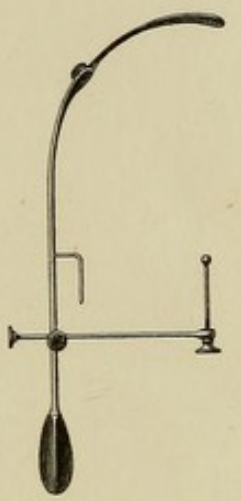


Fig. 1.



Fig. 8.



Fig. 7

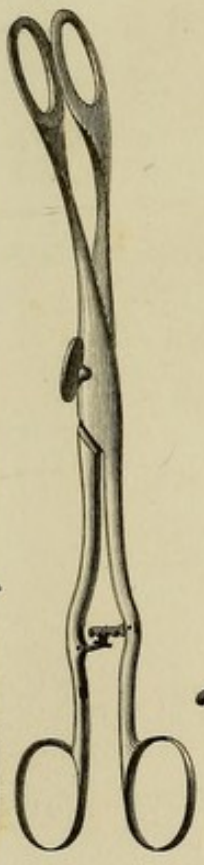


Fig. 6.

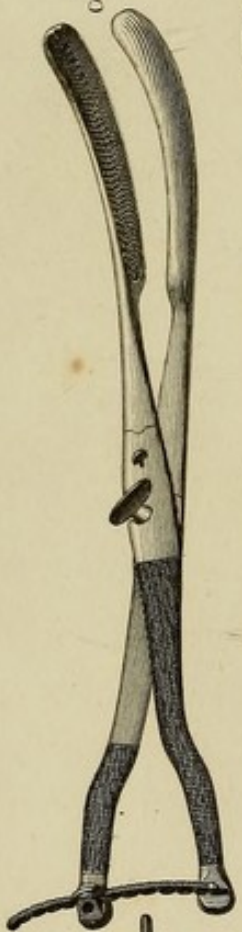


Fig. 6 bis

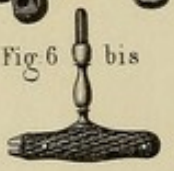
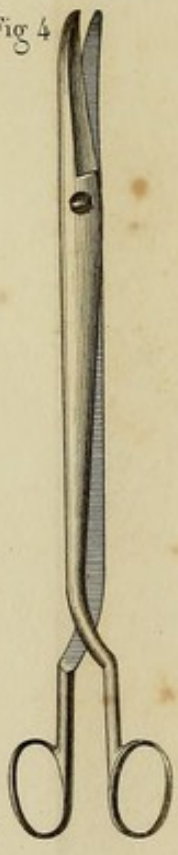


Fig. 5.



Fig. 4



Pl. 1

Fig 1.

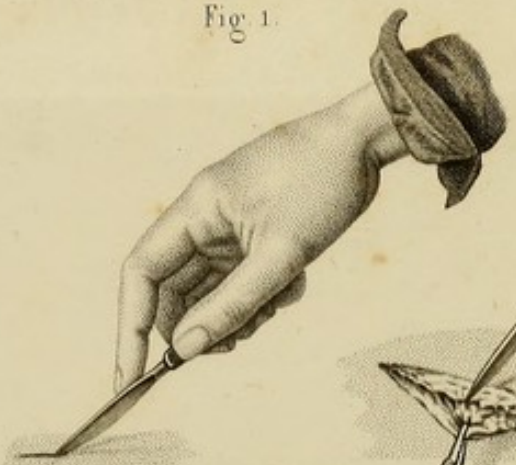


Fig 3.

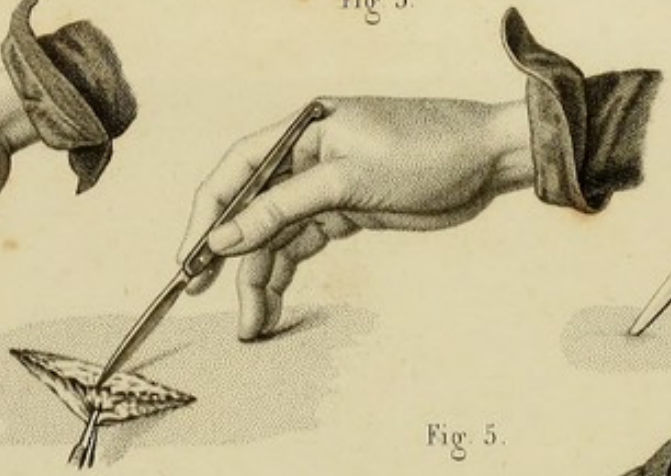


Fig. 4.

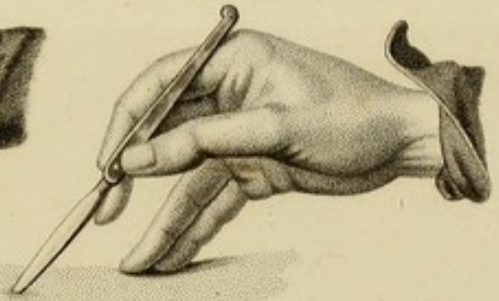


Fig 2.



Fig. 5.

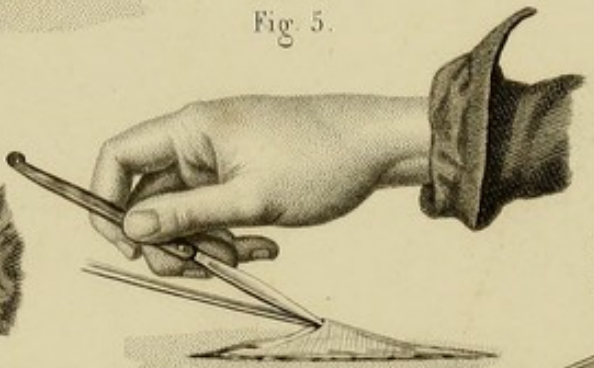


Fig 6.

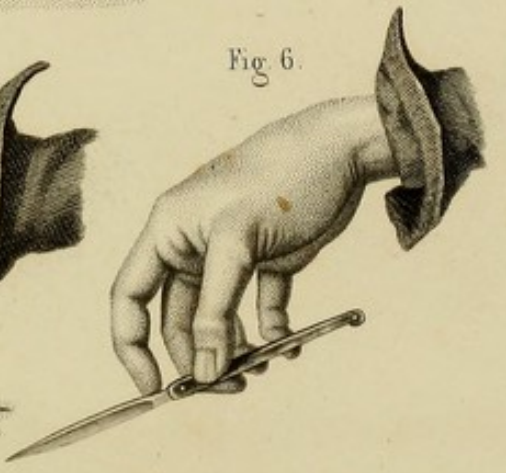


Plate I.

METHODS OF HOLDING THE BISTOURY.

The positions in which the bistoury may be held are liable to infinite variety; nevertheless, for the purposes of operative surgery, these positions may be reduced to three, and each of them subdivided into two varieties.

First Position (fig. 1 and 2). The handle of the bistoury is held firmly in the whole hand, like a table knife. In this position, the end of the handle of the instrument always rests in the palm of the hand, whilst the cutting edge may be turned either downwards (as in fig. 1), when the index finger is extended upon the back of the blade; or upwards (as in fig. 2), when the index is placed near the junction of the blade with the handle, and on its side. The first position is the best, whenever great firmness or force is required in the use of the instrument.

Second Position (fig. 3 and 4). The bistoury is held like a pen in writing, the cutting edge being turned either downwards (fig. 3), or upwards (fig. 4). This position of the instrument is suitable when we desire its movements to be at the same time delicate and precise.

Third Position (fig. 5 and 6). The bistoury is held like the bow of a violin. In one of the varieties of this position, the point of the instrument is carried forward with its edge downwards (fig. 6); in the other the point is carried backwards, with the edge upwards (fig. 5). This position is employed when we wish to use the knife with the utmost delicacy and prudence.*

* In this country, as in England, the ordinary scalpel is most generally employed by surgeons in operations upon the living body, in preference to the French bistoury, as well as in dissections of the dead. And there is a manifest advantage in the employment of a similarly shaped instrument for both purposes, as that instrument which the operator is most in the habit of using will always serve his purpose best under circumstances of difficulty. The shape of the scalpel undergoes slight variations, according to the fancy of individuals, and the above rules with regard to position are entirely applicable to it.—Eds.

INCISIONS.

In cutting the integuments with the bistoury, or scissors, the object ordinarily in view is to open a passage towards deeper seated tissues, either for their simple exposure, or their removal. Under different circumstances, then, the incision may be made either *from without inwards*, or *from within outwards*.

In cutting from *without inwards*, the skin should always be previously put upon the stretch, in order to avoid its wrinkling, and to facilitate its division under the edge of the bistoury, which should always cut by being drawn across the tissues with a suitable amount of pressure, applied so as to leave the cut surfaces perfectly perpendicular.

1st. *Simple Incisions.* The skin being firmly drawn and stretched over the deeper parts by the left hand of the surgeon, or by his assistants, the operator takes a straight bistoury in the first or second position (fig. 1 or 3), plunges it at first perpendicularly to a sufficient depth, and afterwards inclines it to an angle of about 45°, until the incision has reached the desired length, when he brings it out again perpendicularly, in order to avoid making an oblique section of the skin at the end of the cut. The same rules are followed in making all simple incisions, whether straight or curved.

Sometimes it is necessary to avoid with especial care the parts immediately beneath the skin. In such a case the incision should be made with a convex bistoury, held in the third position (fig. 6), dividing the tissues carefully, layer by layer. Or, by pinching up a fold of skin, one end of which is held by an assistant, the bistoury being held in the first position, the fold may be divided by cutting it downwards perpendicularly, or by transfixing its base and cutting outwards in the same direction, a simple straight incision being the result in either case (fig. 2).

2d. *Compound Incisions.* These are formed by the meeting, or intersection, of two or more simple incisions. The principal varieties are: 1st, the incision resembling the letter V, where two simple incisions meet at an acute angle; if they meet at a right angle, it is said to resemble the letter L. 2d, the T incision, where one incision falls perpendicularly upon the centre of another; when they intersect each other at a right angle, a crucial incision is the result; when several incisions converge towards a common centre, they form a star. When several incisions are to be made intersecting each other, it can be done

to the best advantage, especially where the skin is loose and yielding, by making a long straight cut in the first place, and then, whilst firmly stretching its borders by a hand at either end, making the others rapidly across it.

3d. *Incisions from within outwards.* These are effected either with, or without, the assistance of a director. By one method, the bistoury, held in the second or third position, is inserted obliquely beneath the skin, or aponeurosis, or into the sinus which is to be laid open, and then brought up into a perpendicular position, by which movement the parts covering its edge are freely divided, the knife cutting from its heel towards its point. In a second method the instrument, in its first position, is introduced under the skin, with or without a director, to the point where the incision is to be terminated; then thrusting its point through the integuments, from within outwards, the incision is completed by lowering the wrist and cutting out, from the point towards the heel of the knife.

Plate II.

UNION OF WOUNDS.

The different methods of promoting the union of wounds vary according to the nature and condition of the solution of continuity, and the ultimate object which the surgeon has in view. When a wound has commenced to suppurate, we simply, by means of different modes of dressing, endeavor to prevent the gaping of its edges, and the unnecessary retention of the purulent discharge, whilst watching the process of cicatrization. But when immediate union of the wound is sought after, union by the first intention, as it is called, it is necessary that its edges should be retained very accurately in contact, in order that the adhesive inflammation about to develop itself shall effect their permanent agglutination. When wounds are not very irregular in their form, or when they are situated on the extremities, or on a convenient part of the body, it is sometimes possible to keep their edges in accurate apposition by means of position, and the judicious use of adhesive plasters and bandages; but in a great many instances it becomes absolutely necessary to resort to a regular operative procedure, viz.: the application of sutures.

FIG. 2, 3, 4, 5, 6. SUTURES.

The object of the application of sutures is to retain in accurate contact the lips of a wound, when, from its form or position, plasters or bandages will not answer the purpose.

The instruments required for the introduction of sutures are needles and ligatures. The flattened needle of Boyer, curved in the form of an arc of a circle, *a a*, and that of Velpeau, with its eye on the side, curved, but flattened only on its anterior half, *b b*, are in most general use; for particular operations, needles of other shapes are employed—these will be described in their proper connection.* The needle-carrier (fig. 7) is

* The straight round needle with a triangular point, of different sizes, is much used in this city. It answers fully as well in the great majority of wounds as the old-fashioned curved needles, and is unquestionably managed with more facility.—Eds.

Pl. 2.

Fig 9.

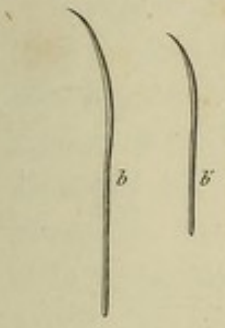


Fig 1.

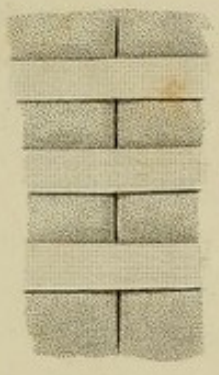


Fig 2.

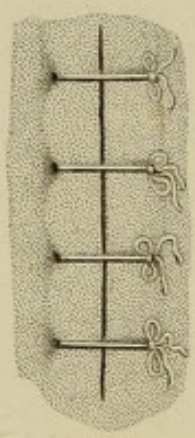


Fig 3.

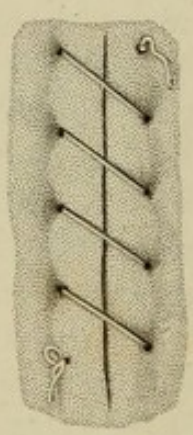


Fig 4.

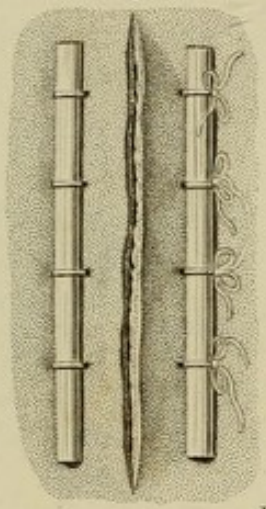


Fig 5.

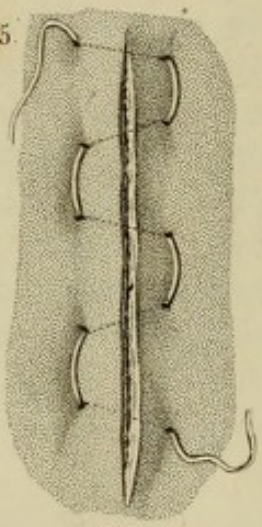


Fig 7.

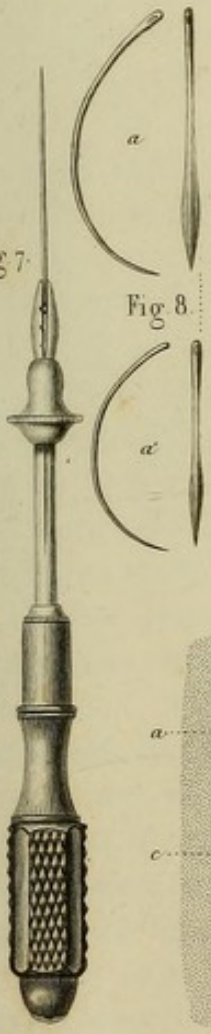
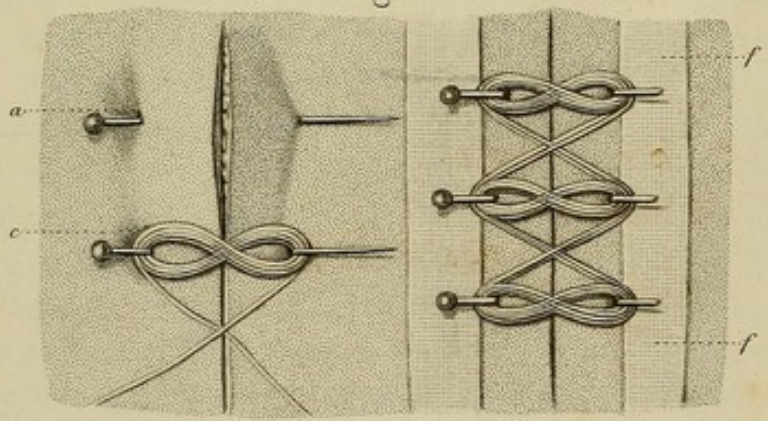


Fig 8.

Fig 6.



only used when the nature of the tissues requires the employment of much force in the introduction of the needle.

In regard to their mode of application, and the manner in which their purpose is effected, sutures are divided into three species. 1st, *The simple, or Pelletier's suture* (fig. 2 and 3), which approximates the lips of the wound, edge to edge; 2d, *The zig-zag, or basting suture* (fig. 5), by which the deeper portions of the cut surfaces are brought in contact; 3d, *The twisted suture* (fig. 6), which effects both of these objects, keeping the deeper portions of the wound together, whilst its cutaneous edges are also maintained in accurate apposition.

1st. *Simple suture* (fig. 3) is effected by passing a needle with its ligature through both of the lips of the wound which are to be kept in contact. To do this the operator passes the needle from without inwards through the right border of the wound at a distance of two to three lines from its edge; its point is then pushed forward in such a manner as to perforate from below upwards the left border of the wound at the same distance from its edge; the convexity of the needle always presenting towards the bottom of the wound. Sometimes the irregular shape of the wound, or the separation of its lips from each other, renders it impossible for both of them to be perforated at the same time by the same needle; in this case a ligature armed with two needles may be employed, each of which is passed through a lip of the wound, from within outwards.

The first point of suture being thus effected, the rest are applied in like manner, until the edges of the solution of continuity are in contact throughout. When several sutures are thus introduced without cutting the thread, the *continued*, or *glover's* suture is the result (fig. 3). On the contrary, when the thread is cut and tied over the wound between each point of suture, it is then known as the *interrupted* suture (fig. 2). Finally when, in place of tying together the ends of each of the threads, they are all brought together in a single bundle, and fastened at a distance, so as to keep up their tension, we have Ledrans', or the *looped suture*, sometimes applied to wounds of the intestines (v. *Enteroraphy*).

2d. *Zig-zag, or basting suture* (fig. 3). This is commenced exactly in the same manner as the simple suture, that is to say, a single needle is inserted through both lips of the wound, but its thread, instead of passing back again across the wound, is carried along, and parallel with, its border, until the next point is reached, from which it is passed again through both of its lips to the side from which it was at first introduced.

The needle being thus inserted alternately from either side of the wound, without the thread being cut, a species of zig-zag is described by it from which the suture takes its name (fig. 5). *The quilled suture* (fig. 4) is evidently a variety of this latter; it tends also to bring together the deeper portions of a wound, only the loops of the ligature which produce this result in the zig-zag suture are here replaced by a piece of a gum elastic catheter, or the barrel of a quill. The manner in which it is done is by passing, in the first place, through the lips of the wound, as many double ligatures as it is wished to make points of suture; the quill or bougie is then introduced, parallel to the edge of the wound, through the loops formed by the doubling of the ligatures, whilst their free ends are tied, with the necessary degree of tightness, over another quill at the opposite side of the wound.

3d. *Twisted suture.* This species of suture combines the results of both of those previously described, only it is done in a different manner; instead of an ordinary ligature, a metallic pin or needle is passed through the lips of the wound—either an ordinary pin, *a*, or the insect pins, which Dieffenbach prefers. By the first step the deeper portions of the cut surfaces are brought in contact, and to produce the same effect upon the cutaneous edges of the wound, a ligature is applied around each pin in the form of the figure 8, its ends being crossed in passing to the next pin, where the process is repeated. The operation is finished by cutting off the points of the pins, and placing a longitudinal strip of adhesive plaster between their extremities and the skin, to prevent the latter from being irritated by the cut ends, *ff*.

Pl. 3.

Fig. 1.

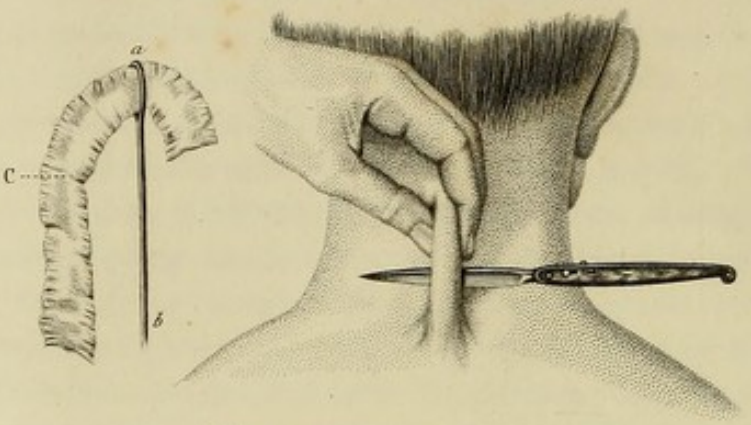


Fig. 1'



Fig. 3.

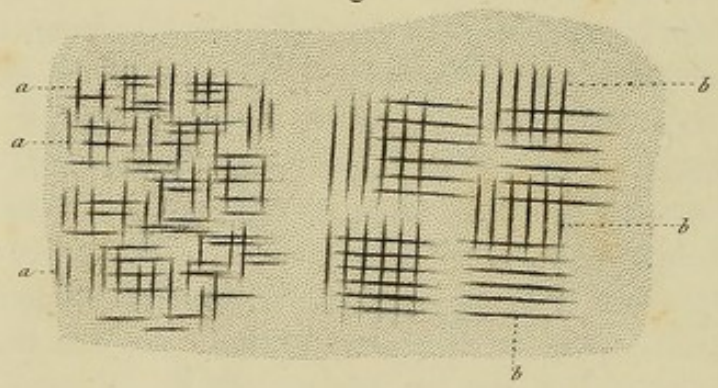


Fig 4



Fig. 3'

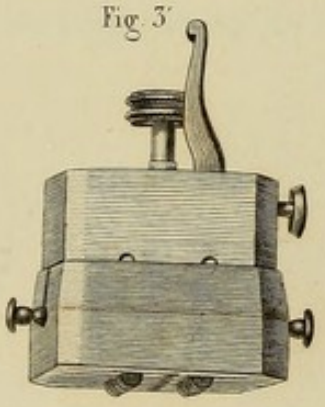


Fig. 2.



Fig 4



Plate III.

OF THE SETON.

The object of the seton is to establish and keep up a drain, or issue, by means of a strip of cotton, or linen tape, introduced beneath the skin. It is most frequently made use of in the nape of the neck, but may be applied with advantage in many other localities.

fig. 1. seton in the nape of the neck.

Having pinched up the skin of the back of the neck in a vertical fold, one end of which is held by an assistant, the operator transfixes the base of the fold by a straight bistoury held in the first position, and enlarges the incisions thus made to the requisite extent; then by means of the eyed-probe, *a b*, the strip of linen, *c*, previously greased with cerate, is passed through the wound made by the bistoury, and the fold of skin is allowed to resume its natural position.

The dressing consists of a piece of linen in which a number of small holes have been cut, spread with cerate and placed upon the wound; over this is a small wad of lint for the purpose of absorbing the discharge which escapes through the holes in the linen, covered by a compress, in the folds of which the excess of the seton is coiled. A circular turn of a bandage around the neck retains the dressing in position, and it should not be renewed until the fourth or fifth day, by which time suppuration will have been established. At each dressing a new portion of the seton, well greased, is drawn into the wound, and the soiled end cut off; when the seton is exhausted a new one is sewed to its extremity.

Boyer's suture needle (fig. 1 *bis*), which carries the seton through at the same time that it makes the wound, may be substituted for the bistoury and eyed-probe. This instrument, however, is not much used.*

* The English seton needle, which differs slightly from Boyer's, is a convenient instrument, and very generally employed in this country; it can be introduced more rapidly and with less pain than the bistoury and eyed-probe.

The substitution of a strip of india-rubber cloth for linen or cotton, is also an im-

FIG. 2. VACCINATION.

Ordinarily the upper and outer part of the arm is selected for the insertion of the vaccine virus. There are four methods of doing this: 1st, *by friction;* 2d, *by a blister;* 3d, *by scarification;* 4th, *by puncture.* We will describe the latter only, which is the mode most in use.

To vaccinate by puncture the ordinary lancet, or what is better, the vaccinating lancet, *a b*, is the instrument generally preferred. This is previously charged with the virus, either by inserting it into a mature vesicle, when we vaccinate directly from arm to arm, or by making use of preserved matter. The lancet is then introduced almost horizontally beneath the surface of the skin to the distance of about a line, the operator endeavoring to make the instrument pass as it were between the epidermis and the true skin; it is allowed to remain for a few seconds and then withdrawn in such a manner as to wipe off the virus from the point of the instrument, the withdrawal of which is generally followed by a small drop of blood. In this manner three or four punctures are made in each arm, which must be allowed to dry perfectly before the infant is dressed.

FIG. 3. SCARIFICATIONS.

The term *bird-peck punctures*, *aaa*, is applied to a number of superficial punctures rapidly made with a lancet-shaped needle, or a well-pointed lancet, with the view of depleting inflamed or œdematous tissues.

Scarifications are small superficial incisions, made close to each other for the purpose of causing a flow of blood; it is a very ancient method of effecting depletion of the capillaries. They may be made with a lancet, a razor, or even a bistoury, held in the third position. With a view of lessening the pain when made in this manner, the Germans have invented a scarificator (fig. 3 *bis*), in which, by means of a spring, some fifteen or twenty small blades are made to cut at one stroke; thus the duration of the operation is much diminished.

FIG. 4. ACUPUNCTURE.

The operation of *Acupuncture* consists in the introduction of needles made for the purpose, *a*, *b*, *c*, into different parts of the body. When

provement, as it does not absorb the discharge from the wound; nor does it require constant renewal and methodical dressing, but may be tied in a loop and allowed to remain, which, with children, is an advantage.—EDS.

the needles are placed in communication with the poles of a machine, with the object of passing a current of electricity through a limb or a diseased part, the operation takes the name of *electro-puncture*. Of late electro-puncture has been employed, and in several instances with success, to produce the coagulation of the blood in arteries, and in this manner to effect a cure of aneurism.

There are different modes of introducing the needles—either suddenly by a single thrust, or in a more gradual manner, by rolling the handle of the needle between the thumb and index finger, whilst pressing it gently onwards. Sometimes also it is driven forwards by a series of gentle taps upon its head. The pain is but trifling by either method.

Plate IV.

1st. BLEEDING FROM THE ARM.

FIG. 1. ANATOMY OF THE PART.

The skin and adipose tissue which cover the veins at the bend of the arm have been removed by dissection, as well as the subjacent brachial aponeurosis, 2, in order to demonstrate the relation of the deeply seated parts with the superficial veins.

These are, reckoning from without towards the inner border of the arm:

A. *The radial vein*, accompanied by some small branches, *a*, of the musculo-cutaneous nerve.

B. *The median cephalic*, crossed by the internal branch, *b*, of the musculo-cutaneous nerve.

C. *The cephalic vein*, formed by the union of the two preceding; the main trunk of the musculo-cutaneous nerve, *c*, lies along its inner border.

D. *The common median vein*, with branches from the musculo-cutaneous and internal cutaneous nerves.

E. The *median basilic*, accompanied by the anterior branch, *e*, of the internal cutaneous nerve. Larger and more superficial than the preceding, the median basilic vein runs parallel, in its external half, with the brachial artery, from which it is separated by the aponeurotic expansion given off by the tendon of the biceps, G. The median nerve, H, also lies behind it.

I. *Ulnar veins.* M, *basilic vein*, formed by the union of the median basilic with the ulnar veins. N, Internal cutaneous nerve.

FIG. 2. METHOD OF PERFORMING THE OPERATION.

The patient being either seated, or lying down, the operator having provided himself with a short bandage, places the centre of it upon the forepart of his arm, about three or four fingers' breadths above the bend of the elbow, and bringing its two ends to the outer side of the arm,

Pl. 4.

Fig. 2.

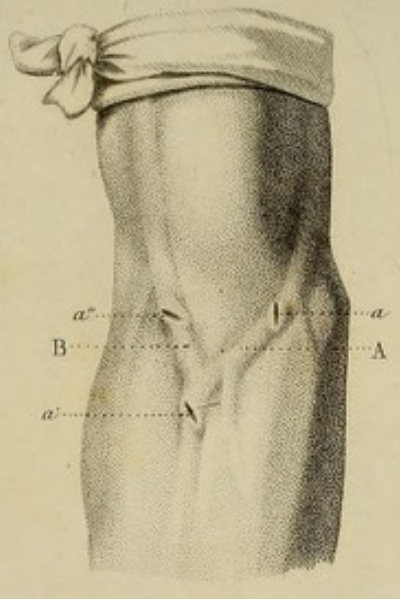


Fig. 4.

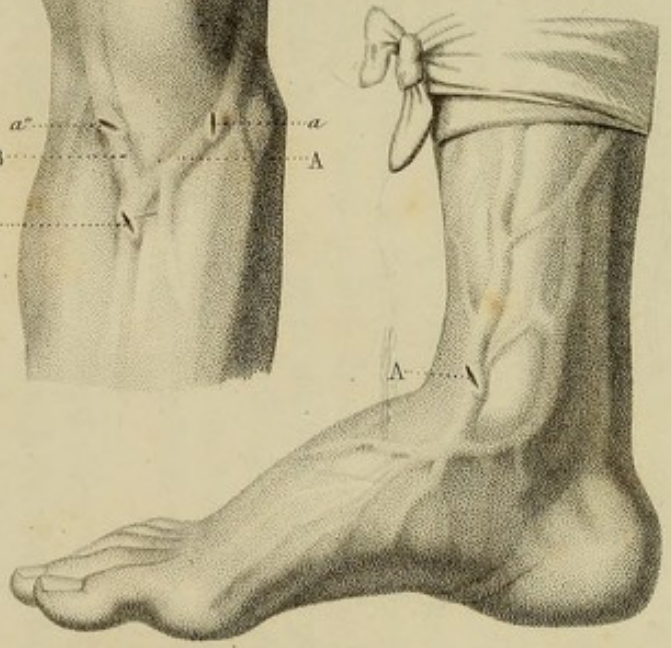


Fig. 1.

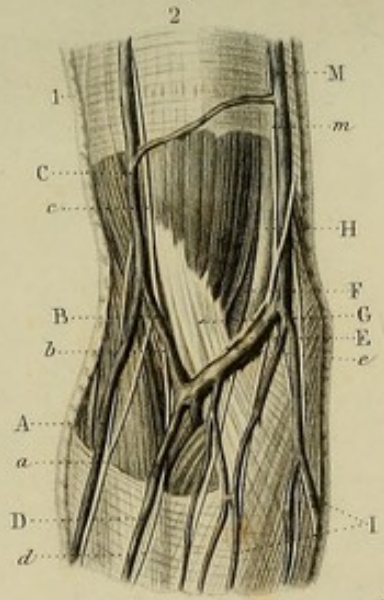
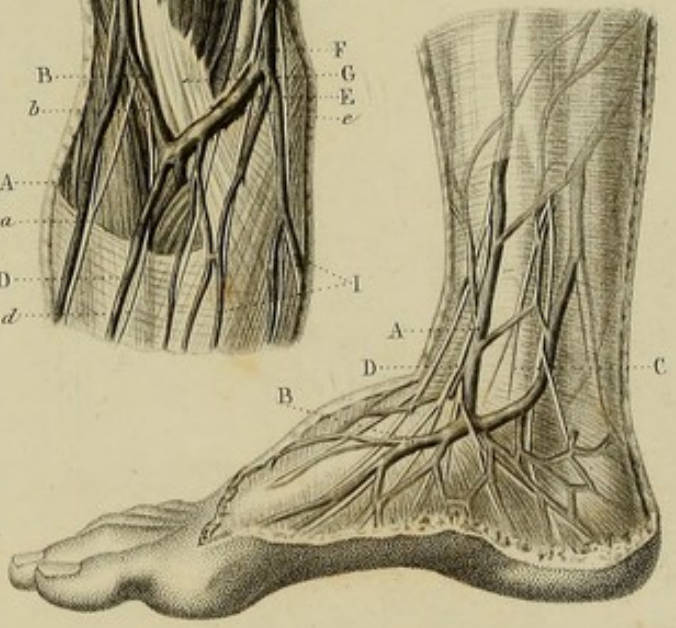


Fig. 3.



ties them in a bow-knot. Whilst the veins are swelling under the influence of this constriction, which, however, should never be carried so far as to control the beating of the pulse at the wrist, the surgeon prepares a small compress, folded in four, for the dressing, and makes ready his lancet, which is done by opening the blade until it forms a slightly obtuse angle with its handles; this he places within his reach, or between the teeth, so that it can be seized at any moment by the heel of the blade.

Then taking the patient's arm, he rotates it outwards, and places its hand beneath his own left arm (if it is upon the right arm that he is about to operate, and *vice versâ*, if on the left,); he now by means of gentle friction pushes along the blood so as to distend the portion of the vein which he is about to pierce, to the utmost, and confines it there by the thumb of his left hand across the vein, whilst the four fingers of the same hand encircle the back part of the patient's arm and their ends put the skin upon the stretch in front. This done, the surgeon takes the blade of the lancet between his thumb and index finger, and makes use of the other fingers as a point of support at the moment of piercing the vein, resting them upon the patient's forearm. The opening of the vein should be made, in most instances, by a simple puncture, obliquely to the general direction of the vein, a, a', a''. Immediately on the puncture being made, the stream of blood jets out with more or less force, and its force can be increased by causing the patient to grasp or squeeze in his hand a cane, lancet-case, or roll of bandage. When the requisite amount of blood has been obtained, it is arrested by applying the thumb of the left hand upon the opening in the vein, whilst removing the bandage from the arm. After having wiped away the blood from the arm, the small compress already prepared is placed upon the wound in the vein, under the thumb, and retained in its situation by a bandage applied around the arm in the form of the figure 8, the ends of which are tied in a knot over the wound, or fastened with a pin.

In bleeding from the arm there are several points worthy of notice, both with regard to the selection of a vein, and the shape of the lancet. Blood can be obtained from any of the veins at the bend of the arm when they can be recognized beneath the skin. The *median* basilic, A, or cephalic, B, are, however, for the most part preferred. What has been said above, applies particularly to the median cephalic; but when the median basilic is the only vein to be found, it is necessary for

the operator to ascertain accurately the position of the artery before opening the vein. It is better, as a rule, to make the puncture as low down in the vein as practicable, because, in this position, the aponeurotic expansion from the tendon of the biceps lies between the two vessels. If at the moment of puncturing the vein, the patient should throw his biceps muscle into a state of strong contraction, as he would, for example, in drawing the operator towards him with the arm, this, by throwing a stronger tension upon the aponeurotic expansion, would raise the median basilic vein, and separate it still farther from the artery which lies beneath it.

The lancet which makes an obtuse angle at its point, called *à grain d'orge*, from its resemblance in shape to a grain of barley, makes a large wound, and suits the great majority of cases (pl. 5, fig. 1); the more pointed pattern, known as the lancet *à grain d'avoine*, from its shape being like that of an oat-grain (fig. 2), and that with a very acute point, called *à langue de serpent* (fig. 3), from its likeness to a snake's tongue, are used when the vein lies very deep and is covered with a thick layer of fat; when using these it is recommended to enlarge the opening in the integuments by making the point of the instrument cut its way out by a lever-like movement succeeding the puncture. In this way a free flow of blood is secured, and the infiltration of the cellular tissue, known as *thrombus*, is prevented.

2D. BLEEDING FROM THE FOOT.

FIG. 3. ANATOMY OF THE PART.

The internal saphœnous vein, A, which takes its origin on the dorsum of the foot, B, passes from below upwards in front of the internal malleolus, C, upon the inner side of the tibia, accompanied by the saphœnous nerve, D. A thin layer of fascia separates it from the skin.

FIG. 4. MODE OF OPERATING.

The venous circulation in the foot is arrested, as in the arm, by means of a bandage placed around the ankle, about two fingers' breadths above the malleoli; after this it is placed in a warm foot-bath, whilst the lancet and dressing are being made ready. When prepared, the surgeon, seated in front of the patient, takes the foot from the water, and having wiped it places it upon his knee; he then secures

the vein, A, in its place with the thumb, as it is very apt to roll in this locality, and proceeds to open it precisely as in bleeding from the arm. It is rarely the case that the blood flows from the foot in a jet, and the custom is to replace the foot in the vessel of warm water until its deepened color, or the length of time of immersion, indicates that a sufficient quantity of blood has been lost.

The dressing consists of a small square compress over the wound, kept in place by a bandage in the form of the figure 8, around the foot and ankle.

Plate V.

Fig. I. Lancets.—1, à grain d'orge; 2, à grain d'avoine; 3, à langue de serpent.

a, blade of the lancet; *e*, heel of the blade; *g*, sheath of the lancet; *h*, *h'*, the two portions of the sheath; *f*, joint of the blade and its sheath.

Fig. II. Bleeding from the external jugular vein, B; arteriotomy in the temporal artery, A.

BLEEDING FROM THE JUGULAR.

FIG. 2. ANATOMY OF THE PART.

The external jugular vein, which is sometimes solitary, and at others double in its origin, in the latter case commencing by two branches which unite in a common trunk about the middle of the neck, takes its course normally from the angle of the lower jaw to the middle of the clavicle. Passing obliquely backwards from its point of origin, it crosses the course of the sterno-cleido-mastoid muscle, and lies upon it, covered throughout by the platisma myoides and the skin. In the upper part of its course it has near it some small nervous filaments.

MODE OF OPERATING.

The patient being seated, or, still better, in reclining position, the circulation is arrested by a compress placed upon the vessel a short distance above the clavicle. The compress, which should be somewhat thick, is kept in its place by a bandage, A, which is tied in the arm-pit of the opposite side. A simple piece of cord, rather tightly tied, might readily take the place of the compress and bandage, for the cord buries itself in the skin and compresses the vein very accurately at the point where it is crossed. The vein being by this means sufficiently distended, the surgeon steadies it with his index finger, and makes the puncture, B. The opening in the vein in this region of the neck should be full

Pl. 5.

Fig. 1.

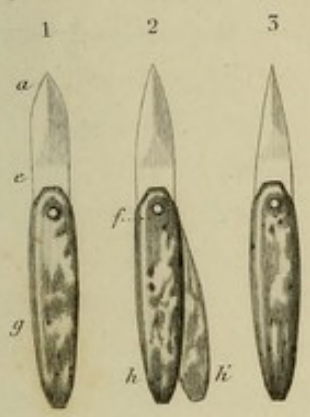


Fig. 2.



large, and directed obliquely across the fibres of the platisma muscle, for being thus divided the muscular fibres retract and keep the wound gaping. It happens very often that the blood will not flow in a jet, but trickles down the neck; in this case a common card should be folded longitudinally, so as to form a gutter, by which the blood can be guided into a proper vessel.

The flow of blood is stopped by removing the compression, and at the same time a finger should be placed upon the wound to prevent the entrance of air into the vein. The wound is dressed by bringing its edges together and applying a piece of adhesive plaster, or the common court plaster. Sometimes this dressing, and even the addition of a circular bandage, does not succeed in stopping the flow of blood entirely; in such a case M. Magistel suggests the introduction of a point of suture.

ARTERIOTOMY.

SURGICAL ANATOMY.

A′ represents the course of the temporal artery; *b′*, the section of the skin; *c′*, pyramidal compresses for compression of the artery.

The temporal artery, a branch of the external carotid, when opposite to the condyle of the lower jaw, runs directly upwards behind the arch of the zygoma. About the middle of the temporal region it divides into two branches: the posterior, which passes backwards, and the anterior, or frontal, which runs upwards and forwards upon the forehead, where it lies upon the epicranial aponeurosis, and immediately beneath the skin.

MODE OF OPERATING.

The patient being properly placed, either sitting or lying, the exact position of the artery is ascertained by its pulsations, and it is steadied by the thumb and index finger of the operator, the skin covering it being rendered tense at the same time. He then, with a straight bistoury, held in the third position, makes a short incision directly across the course of the artery, by which it is divided. The blood issues sometimes in a jet, though more frequently it only trickles; in order to stop it, when necessary, compression is made on either side of the wound by means of the pyramidal compresses, *c*, *c′*, which are retained in their places by a circular bandage around the head, knotted over the temples.

Plate VI.

LIGATURE OF ARTERIES.

1st. on the effects produced by the ligature upon an artery.

Fig. 1. Arteries are composed of at least three membranes placed one upon the other, called *coats: a*, the external coat, possesses the most vitality, is tough and very resisting; *b*, the middle coat, is yellow, elastic, composed of circular fibres, possesses very little power of resisting force applied in the direction of the course of the vessel, and a low degree of vitality; *c*, the internal coat, thin, smooth, transparent, endowed with little strength and no vitality, is regarded as an analogue of the epidermoid tissues.

Fig. 2. When a ligature, *a*, is applied to an artery, the internal and middle coats, *b*, *c*, are divided by the thread, and pushed aside, so that the internal surfaces, *c*, *d*, of the outer coat, the only one which resists the action of the ligature, are brought into forcible contact.

Fig. 3. After the application of a ligature to an artery, the first collateral branch, *a*, above the ligature becomes dilated; in the space between the ligature and this first collateral branch the blood stagnates, and shortly forms a clot, *b*, the office of which is to plug up the artery after the ligature has come away.

Fig. 4 and 5. The process of torsion, *a*, produces an effect upon the arterial coats analagous to the ligature, that is to say, it effects a division of the internal and middle coats, *b*, *b*, which are forced to either side, whilst the external coat, *c*, alone offers resistance, and becoming twisted, serves to obliterate the calibre of the artery.

Fig. 6. After the circulation of the blood through an artery has been interrupted, by a ligature or any other means, it becomes re-established beyond the obstruction by the dilatation of the anastomoses between the collateral branches above and below the ligature. Fig. 6, taken from Dupuytren's Museum, represents an aneurism, *a*, of the popliteal artery which was cured by the application of ice. We can readily recognize the very considerable dilatation of the articular arteries,

Pl. 6.

Fig. 1.

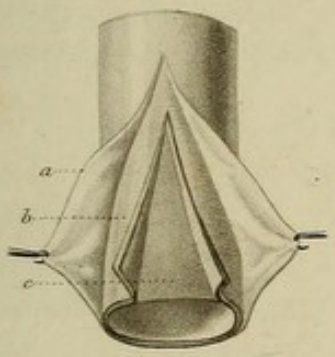


Fig. 2.

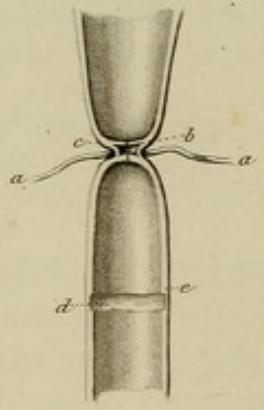


Fig. 3.

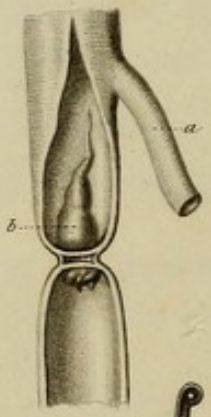


Fig. 7.

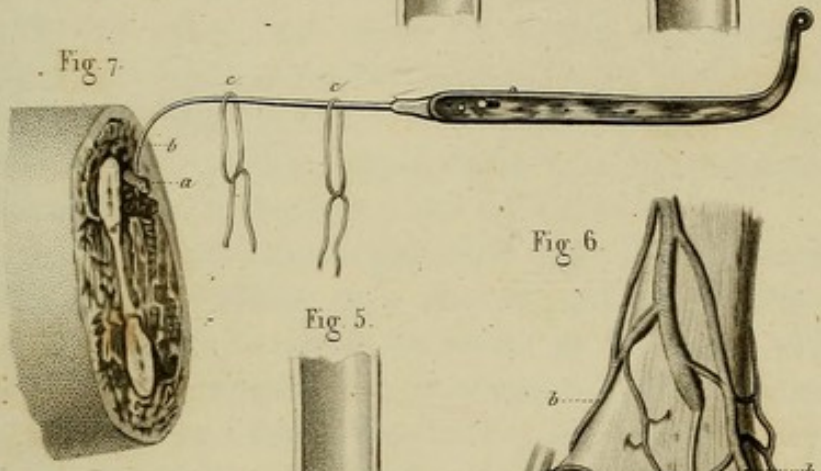


Fig. 6.

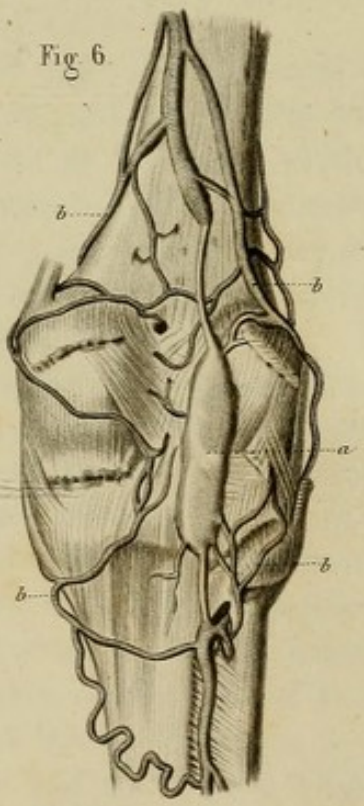


Fig. 5.



Fig. 4.



b, *b*, *b*, *b*, through which the circulation in the limb below has been preserved.

Fig. 7. *a*, an artery in a stump, transfixed by the point, *b*, of the tenaculum; *c*, *c'*, ligatures to be applied to the artery.

2D. GENERAL RULES FOR THE LIGATURE OF ARTERIES.

To lay bare an artery for the purpose of placing a ligature upon it it is necessary:

1st. To determine the position of the vessel, by the requisite familiarity with its anatomical relations, assisted by the arterial pulsations —if the operation is performed upon the living body.

2d. The skin being placed upon the stretch, an incision is made upon the vessel with a convex bistoury held in the third position; this incision, parallel with the course of the artery, should always divide both the skin and the subcutaneous cellular layer, and its length should be proportioned to the depth at which the vessel lies.

3d. The aponeurotic layer which binds down the muscles is to be divided to the same extent, on a director, and the muscles beneath pushed to either side to expose the sheath of the vessel, which contains the artery, in company with its corresponding veins and nerves.

4th. After raising a fold of the sheath of the vessel with the dissecting forceps, it is to be opened with great care, the edge of the bistoury being kept parallel to the artery, and never turned towards it.

5th. The bistoury is then relinquished, and the surgeon makes use of the director, held as a writing pen, to isolate the artery on either side, and endeavors with its point to tear through the loose cellular tissue which surrounds it, so as to pass the instrument behind the vessel. In this stage of the operation there are two important precautions to be observed; in the first place, to lay bare the artery to as trifling an extent as possible, and secondly, to introduce the director between the artery and the vein, so that the latter shall not be exposed to injury from the point of the director as it passes beneath the artery.

6th. When the artery is well exposed and the director lodged beneath it, the operator satisfies himself of its identity by recognizing its pulsations, and then passes along the groove of the director an eyed-probe, armed with the ligature. When the vessel is deeply situated, Deschamps' or Cooper's artery-needle is substituted for the eyed-probe.*

* The highest American authority in regard to the mode of tying arteries, Prof. Mott, does not make use of the director as described above, but employs in its

Finally, being assured of the identity of the artery, the first knot in the ligature is tied. If the vessel is deeply placed, the knot should be tightened by means of the two index fingers inserted into the wound, one of them pressing upon each end of the ligature, in order that the artery should not be too much dragged from its bed. The second knot is then tied, one of the ends of the ligature cut off, and the remaining one brought out at the most depending angle of the wound.

place the smooth round point of the artery-needle which bears his name, and which is also known as the American needle. After opening the sheath of the vessels, and separating it from the artery with the handle of the scalpel, he insinuates the point of this needle, which he considers by far the best instrument of its kind, gently between the vein and artery, and passes it beneath the latter, always keeping the point *from the vein*, and disturbing the connections of the artery as little as possible. As there is probably no surgeon living who has operated upon the arteries more extensively, or more successfully, than Prof. Mott, we can do no better than to follow his method in this respect.—Eds.

Fig. 1

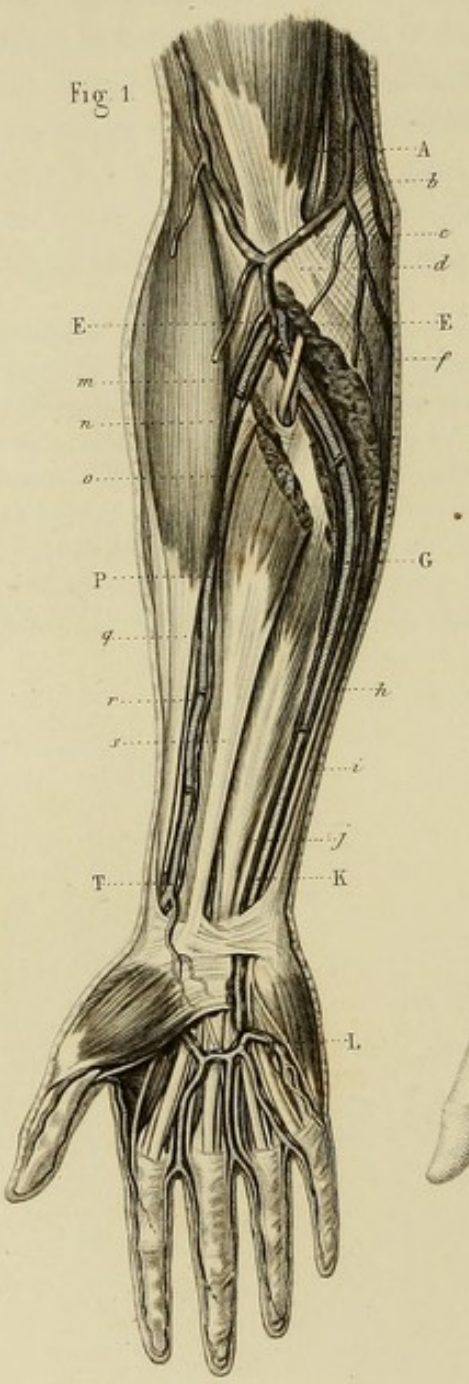


Fig. 2

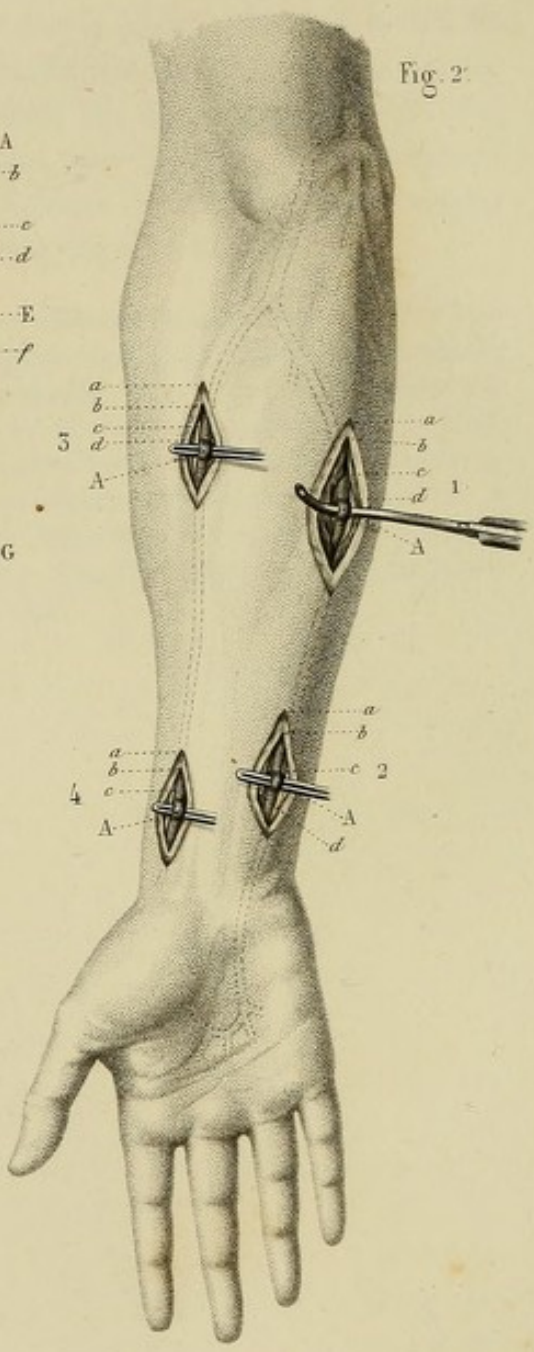


Plate VII.

LIGATURE OF THE ULNAR AND RADIAL ARTERIES.

FIG. 1. SURGICAL ANATOMY.

A, Brachial artery, accompanied on its inner side by the median nerve, *b*.

c, median basilic vein, crossing the course of the brachial artery and median nerve, from which it is separated by the aponeurotic expansion, *d*, given off by the tendon of the biceps.

Incision No. 2 represents the *ligature of the ulnar artery in its lower third*, *a*, incision in the skin; *b*, edges of the divided aponeurosis; *c*, ulnar nerve; *d*, tendons of flexor *sublimes*; A, radial artery with the director beneath it.

Incision No. 3. *Ligature of the radial artery in its upper third.* *a*, wound in the skin; *b*, edges of the aponeurosis; *c*, radial nerve; *d*, internal border of the *supinator longus;* A, radial artery with the director beneath it.

Incision No. 4. *Ligature of the radial artery at the wrist.* *a*, wound in the skin; *b*, aponeurosis; *c*, radial nerve; A, radial artery on the director.

MODE OF OPERATING.

§ 1. *Ligature of the radial artery at the wrist* (see incision No. 4). 1st, Along the external border of the tendon of the *flexor carpi radialis*, which is always easily recognized, make an incision from one and a half to two inches in length through the skin and sub-cutaneons cellular tissue. 2d, Divide the aponeurosis of the fore-arm upon a director; recognize, isolate, and place a ligature beneath the artery, which is situated just external to the tendon of the *flexor carpi radialis*, always easily known by its pearly color.

§ 2. *Ligature of the radial artery in the upper third of the fore-arm*—(see incision No. 3).

Upon the internal border of the *supinator longus* muscle, if it can be recognized, and if not, along a line, representing the course of the

artery, and drawn from the middle of the bend of the elbow, to the inner side of the styloid process of the radius, let an incision be made from two and a half to three inches in length, taking care to avoid the superficial veins. The deep fascia being laid open on the director, the inner edge of the supinator ongus muscle is to be sought for beneath it. This landmark being determined, on drawing the muscle a little outwards with a spatula or blunt hook, the artery will be discovered enclosed in its sheath with its two *venæ comites*, from which it is to be isolated and tied.

§ 3. *Ligature of the ulnar artery in the lower third of the forearm* (see incision No. 2). 1st. Along the external border of the tendon of the *flexor carpi ulnaris*, or if it is preferred, in the course of a line drawn from the internal condyle of the humerus to the prominence of the pisiform bone, let fall an incision from one and a half to two inches in length, dividing the skin and subcutaneous cellular tissue; 2d. The deep fascia being then laid open upon the director, the tendon of the *flexor ulnaris* will be seen, and it must be pushed towards the inner side; 3d. The artery, which is beneath it, between its two accompanying veins in their common sheath, is then to be isolated, and the ligature inserted beneath it.

§ 4. *Ligature of the ulnar artery in the middle of the forearm* (see incision No. 1). 1st, Upon the imaginary line just indicated make an incision three inches in length through the skin and cellular tissue; 2d, endeavour to find the first intermuscular septum which can be detected, going from within outwards; 3d, divide it upon the director, and push the fibres of the *flexor sublimis* towards the outer side of the limb, when the artery will be discovered immediately beneath it, with its veins. After having laid open the sheath of the artery, it will be found most convenient to make use of Cooper's or Deschamps' needle, on account of the depth of the wound.

Pl. 8.

Fig 1.

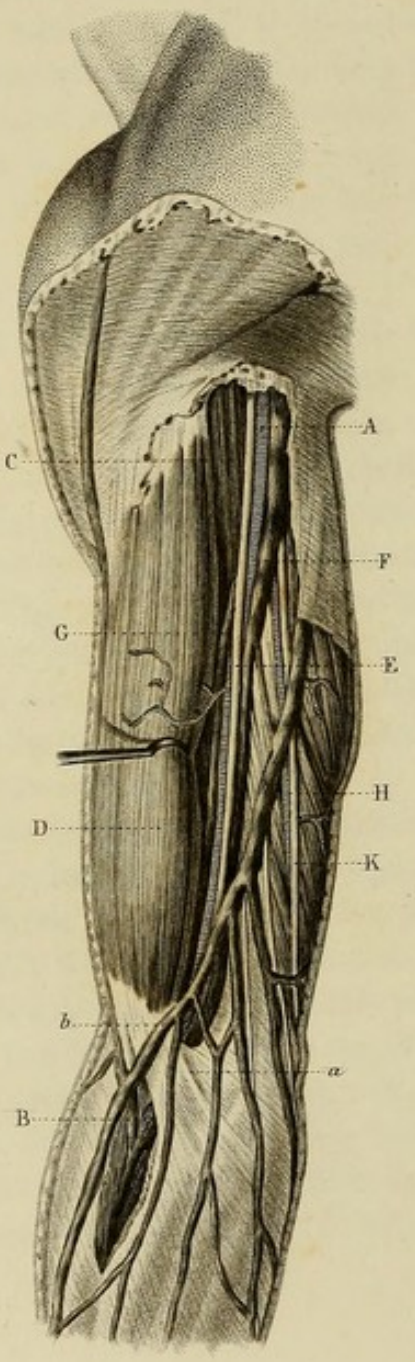


Fig 2.

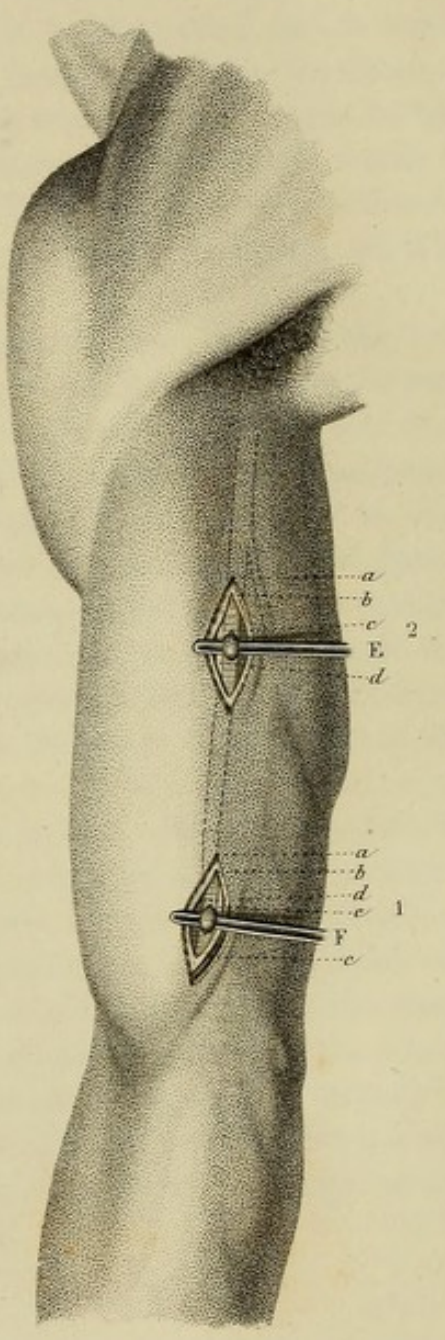


Plate VIII.

LIGATURE OF THE BRACHIAL ARTERY.

FIG. 1. SURGICAL ANATOMY.

AB, *Brachial artery.*—It extends from the inferior limit of the axilla to about an inch below the articulation of the humerus with the ulna. Situated on the inner side of the humerus above, it inclines gradually outwards in descending the arm, and at its lower part lies in front of the bone.

In its upper fourth the artery is in relation with the inner edge of the *coraco-brachialis* muscle C; below, it corresponds with the internal border of the biceps, D, which slightly overlies it in its two inferior thirds. In emaciated subjects it is covered only by the integuments and deep fascia of the arm. Towards its termination, it lies along the inner edge of the tendon of the *biceps*, whilst about to pass beneath the aponeurotic expansion, *a*, given off by the latter, which separates it from the median basilic vein, *b*.

E, *The median nerve*, which accompanies the artery thoroughout its course, enclosed with it in a common aponeurotic sheath. Above, the nerve is external to the artery; towards the middle of its course, it passes in front, and below, in its inferior third, it lies internal to it. The *radial and ulnar nerves* lie behind, and to the inner side of the artery, but only at its upper part.

FG, *Humeral veins.*—The vein on the inner side of the artery is larger than that on the outer side; in their course down the arm, they form frequent anertomoses with each other.

H, The *inferior profunda*, branch of the brachial artery which passes backwards in company with the ulnar nerve, K.

FIG 2. OPERATION.

Incision No. 1. *Ligature of the brachial artery near the bend of the elbow.* *a*, incision involving the skin and cellular tissue; *b*, edges of the divided aponeurosis of the arm; *c*, median basilic vein, situated between the skin and aponeurosis, and pushed out of its place towards

the inner condyle; *d*, inner edge of the *biceps* muscle; *e*, median nerve on the inner side of the artery; F, artery isolated from its sheath, with the director beneath it.

Incision No. 2. *Ligature of the brachial artery at the upper part of the arm.*—*a*, incision through the integuments; *b*, incision of the deep fascia; *c*, brachial vein; *d*, median nerve, external to the artery; E, artery isolated, and raised upon the director.

MODE OF OPERATING.

§ 1. *Ligature of the brachial artery at the bend of the elbow* (see incision No. 1). 1st, Make out distinctly the tendon of the *biceps*, and the internal border of this muscle.

2. Make an incision at least two inches long, following the curve of the inner edge of the *biceps*. In this incision through the integuments, the precaution must be taken to push the basilic vein on one side, in order that it may not be wounded.

3. The deep fascia, in this situation, is the aponeurotic expansion given off by the tendon of the biceps; it is to be laid open on the director.

4. Beneath it is seen the artery with its veins, and on its inner side, the median nerve; the sheath is to be opened by cutting upon it obliquely, and the artery carefully isolated and tied.

§ 2. *Ligature of the brachial artery in the upper part of the arm* (see incision No. 2). 1st, after having distinctly recognized the internal bordor of the *biceps* muscle, make an incision parallel to it about two inches and a half in length, through the skin and cellular tissue.

2d. Lay open the deep fascia on a director.

3d. Look for the nervous trunk which lies nearest the inner edge of the *biceps*; it is the median nerve, beneath and to the inner side of which the artery will be found.

4th. Open the common sheath of the vessels, by lifting a fold of it with the forceps and holding the knife horizontally; then push the median nerve outwards, isolate the artery, and pass the director beneath it from without inwards.

Pl. 9.

Fig 1.

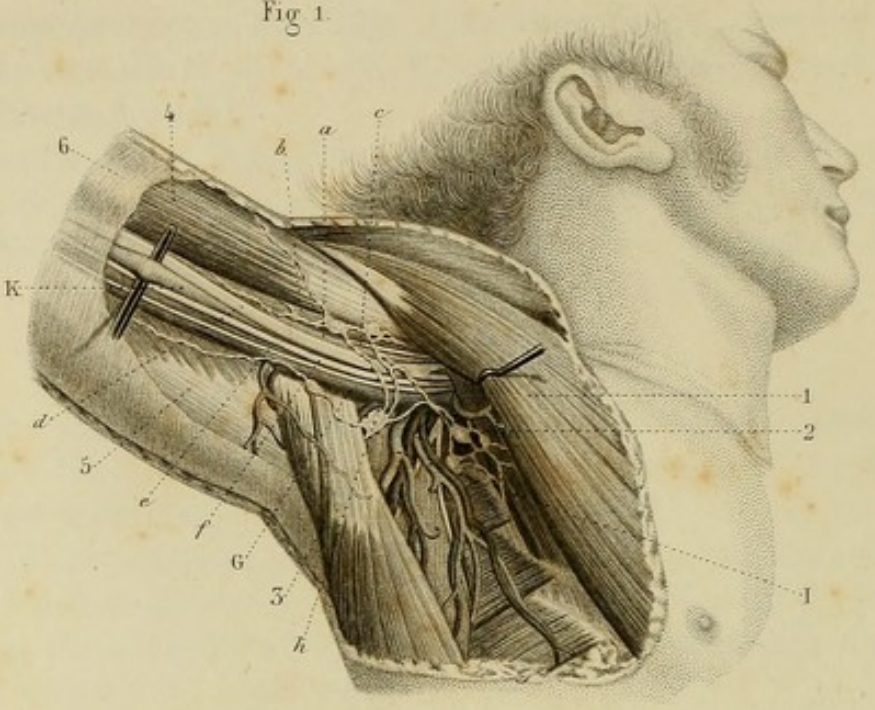


Fig 2.

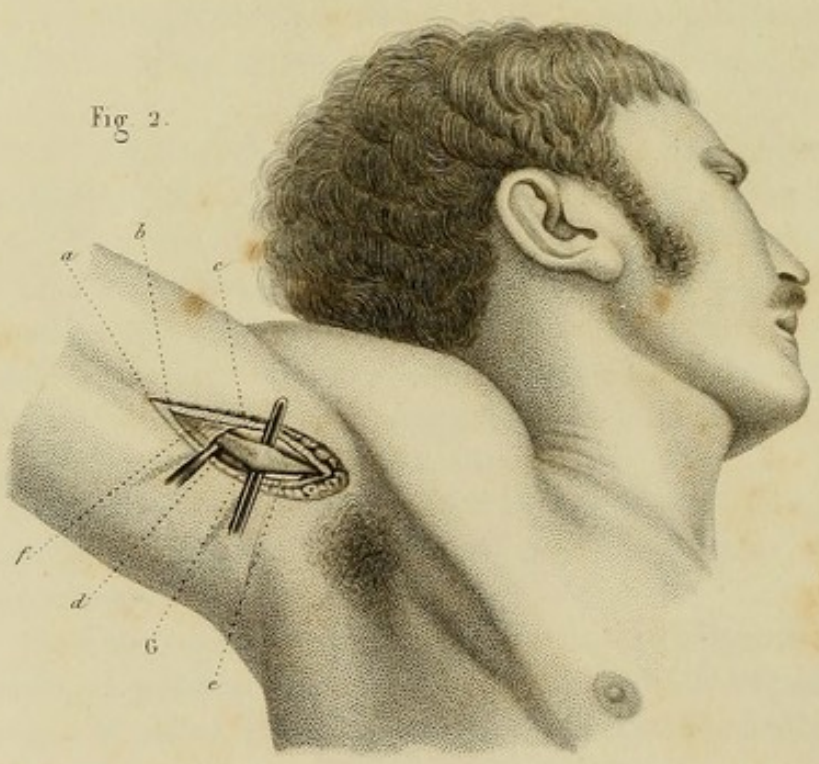


Plate IX.

LIGATURE OF THE AXILLARY ARTERY.

FIG. 1. SURGICAL ANATOMY.

1, *Pectoralis major* muscle drawn upwards; 2, *pectoralis minor;* 3, *Latissimus dorsi* and *teres major* muscles; 4, *biceps* muscle; 5, *triceps extensor cubiti;* 6, deep fascia of the arm.

a, Axillary artery. A continuation of the subclavian artery, it commences at the lower border of the first rib, and ends at the inferior boundary of the axilla (the lower border of the *latissimus dorsi* muscle); its course corresponds with a line dividing the anterior from the middle third of the axilla. In its inferior half it is in relation externally with the inner side of the humerus, against which it may be readily compressed; internally it is covered only by the integuments and deep fascia, and its pulsations can be easily felt.

b, coraco-brachialis muscle, in contact with the artery throughout its course. The artery is always to be found at the internal and posterior border of this muscle, which serves as a reliable landmark.

c, d, e, f, branches of the brachial plexus of nerves. They surround the artery very closely below the *pectoralis minor* muscle; *c*, the *musculo-cutaneous* nerve lies along the outer side of the artery; *d*, the median, the largest branch of the plexus, takes its origin by two roots, which meet in front of the artery, opposite the lower border of the *pectoralis minor* muscle; this nerve, skirting along the inner border of the *coraco-brachialis* muscle, lies in front and a little to the outer side of the artery; *e, internal cutaneous* nerve, a small branch which takes its origin from the innermost root of the median, lies in front and to its inner side. Finally, the *ulnar* nerve, *f*, and the *radial*, which is concealed by the axillary vein, are situated still farther within and behind.

G, the axillary vein, is situated in front of the artery and nerves, which it partly conceals.

The axillary vessels and nerves are surrounded and held together by

a loose cellular tissue, which is interspersed with numerous lymphatic vessels and glands, *h*.

I, the subscapular, and inferior thoracic arteries and veins.

K, brachial artery, continuation of the axillary, isolated from the nerves and veins which surround it.

FIG. 2. OPERATION.

a, incision of the skin, cellular and adipose tissues; *b*, deep fascia; *c*, median nerve, pushed upward; *d*, axillary vein, depressed by a blunt hook; *e*, internal cutaneous nerve; *f*, sheath of the axillary vessels; G, axillary artery upon the director, which has been passed from within outwards, and from below upwards.

MODE OF OPERATING.

The operation of tying the axillary artery in the axilla, below the *pectoralis minor* muscle, is described as Lisfranc's method; it is as follows: 1st, determine the position of the artery by drawing a straight line corresponding with the union of the anterior third with the posterior two-thirds of the axilla, or by feeling, if possible, for the internal edge of the *coraco-brachialis* muscle, the guide for the artery. 2d, carefully divide the skin and cellular tissue on this line to the extent of two inches and a half. 3d, as soon as the fasciculus of vessels and nerves is in sight, lay aside the bistoury, and relax the parts by slightly lowering the arm. 4th, endeavor then to recognize the *coraco-brachialis* muscle, and make use of it as a guide to the position of the artery. 5th, by the aid of the director, starting from the *coraco-brachialis* muscle, first push the median and internal cutaneous nerves in front, and then the ulnar and musculo-spiral towards the posterior border of the wound; in the interval between them the artery and vein will be found. 6th, separate with care the artery from the vein, and pass the needle beneath it, from behind forwards, in order not to injure the vein, which in this locality requires more care than the nerves.

Fig 2.

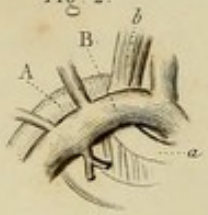


Fig 1.

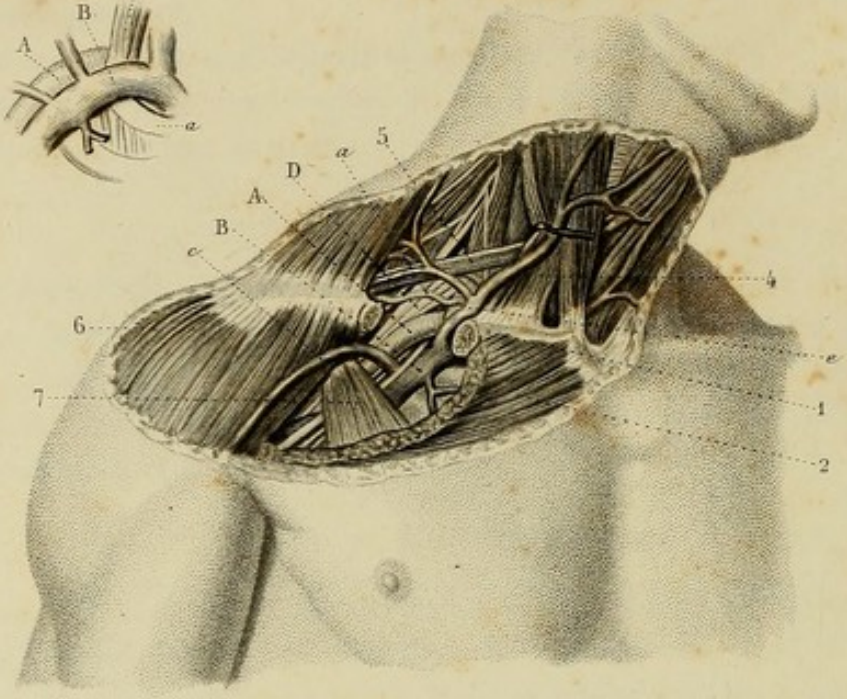


Fig 3

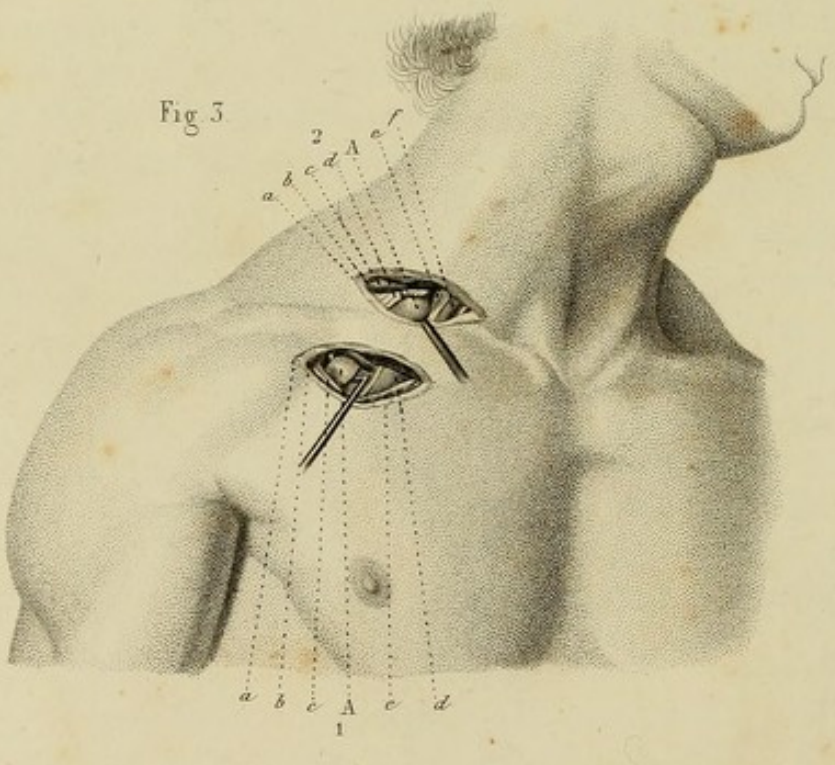


Plate X.

LIGATURE OF THE AXILLARY AND SUBCLAVIAN ARTERIES.

(*For the origin and collateral branches of the subclavian arteries, see pl.* 11.)

FIG. 1 AND 2. SURGICAL ANATOMY.

FIG. 1. 1, the clavicle and *pectoralis major* muscle, cut away partially, 2, in order to expose the axillary vessels; 3, the *trapezius* muscle; 4, sterno-mastoid; 5, omo-hyoid; 6, deltoid; 7, *pectoralis minor.*

A, the axillary artery; in its upper half, it is covered successively by the insertion of the pectoralis minor, 7, higher up by the *pectoralis major* muscle, from which it is separated by a layer of adipose tissue, containing numerous small veins and arteries; and finally by the fascia and the skin. *a*, The supra-scapular artery which crosses the base of the neck just above the clavicle.

B, the *axillary vein*, situated in front and to the inner side of the artery, is not in immediate contact with it. The *cephalic vein*, *c*, passes upward in the interspace between the deltoid and *pectoralis major* muscles, crosses the axillary artery above the superior border of the *pectoralis minor*, and empties into the axillary vein.

D, the *nerves of the brachial flexus*, lie behind and above. A thoracic branch often crosses the course of the artery, sometimes in front, and sometimes behind it.

FIG. 1 and 2. A, the *subclavian artery*, taking its origin from the innominata on the right side, and from the arch of the aorta on the left, passes upwards, curves in the form of an arch over the first rib, *a*, and runs downwards and outwards to the first intercostal space, where it takes the name of *axillary artery*. On account of the difference in their origin it will be seen that the first, or ascending portion of the left subclavian, is somewhat longer than the corresponding division of the right. (See pl. 11, fig. 1.)

The *subclavian artery*, after passing between the scaleni muscles, runs downwards upon the first rib, *a* (fig. 2), in a groove situated just

outside of the tubercle into which the *scalenus anticus* muscle, *b*, (fig. 2,) is inserted, which tubercle Malgaigne pointed out as an excellent landmark in searching for the artery. Beyond the *scaleni* the artery lies in the supra-clavicular triangle, which is bounded below by the clavicle and the *subclavius* muscle; within, by the sterno-mastoid, 4, which often overlies it slightly with its external border; and on the outside by the *omo-hyoideus*. Here the artery is covered only by the deep cervical fascia, the platisma myoides muscle, and the skin; still lower in its course it is covered by the clavicle and *subclavius* muscle. In persons with long necks the first rib rises above the clavicle, and in this case the artery may be readily compressed directly against it by pushing the clavicle slightly downwards.

B, the *subclavian vein*, situated somewhat lower down and in front of the artery, is separated from it by the insertion of the *scalenus anticus* muscle, *b*, fig. 2. The external jugular vein, *e*, may cross in front of the artery whilst passing down to empty into the subclavian vein.

D, the *nerves of the brachial plexus*, lie above and behind the artery; they are only in relation with it below and posteriorly.

FIG. 3. OPERATIONS.

Incision No. 1. *Ligature of the axillary artery.*—*a*, incision of the skin; *b*, deep fascia; *c*, upper border of the *pectoralis minor*; *e*, fibres of the *pectoralis major* cut across; *d*, axillary vein; A, axillary artery, below the point where the cephalic vein empties into the subclavian, with an artery needle passed beneath it.

Incision No. 2. *Ligature of the subclavian artery outside of the scaleni.*—*a*, incision in the skin; *b*, deep fascia; *c*, omohyoid muscle; *d*, nerves of the brachial plexus; *e*, *scalenus anticus* muscle; *f*, subclavian vein; A, subclavian artery.

MODES OF OPERATING.

§ 1. *Ligature of the axillary artery below the clavicle.*

1. *Ordinary method.*—The muscles of the shoulder being perfectly at rest, the elbow slightly separated from the trunk, and the head inclined to the opposite side, the surgeon makes, from eight to ten lines below the clavicle, and parallel with it, an incision involving the skin, platisma and subcutaneous cellular tissue, and extending from the septum between the *pectoralis major* and deltoid muscles, to a point two

fingers'-breadth outside of the sterno-clavicular articulation. The muscular fibres of the *pectoralis major* being successively divided and pushed aside, the posterior fascial investment of this muscle (the coraco-clavicular aponeurosis) is brought into view. Then, to favor the separation of the edges of the wound, the shoulder should be depressed, and the fascia torn through with the point of a director. The finger being introduced into the wound to press downwards and outwards the *pectoralis minor* muscle, the following parts can be recognized: 1st the vein, distended with blood; 2d, the axillary artery, farther on the outside and behind it; 3d, the nerves of the brachial plexus, situated still higher up and farther behind. Whilst passing the ligature beneath the artery, it is important that the vein should be pressed to the inner side by the finger, in order that it may be protected from injury from the point of the director, or needle, as it is introduced between the vessels.

By this method, the artery is tied in a triangular space which is bounded above by the clavicle, below and on the outer side by the *pectoralis minor* muscle, and below and on the inner side by the sternal portion of the *pectoralis major*.

II. *Desault's method.*—This consists in making an oblique incision, about three inches in length, following the interspace separating the deltoid and *pectoralis major* muscle, which contains some cellular tisue and fat, as well as the cephalic vein, which must be carefully avoided. The object in this operation is to reach the axillary artery below the *pectoralis minor* muscle.

III. *Chamberlayne's method.*—Make an incision three inches in length below the clavicle, and join it by anothor of the same extent, corresponding to the interspace between the deltoid and *pectoralis major* muscle. This method, as is seen, unites the incision employed by Desault, with that of the ordinary method. The result is a triangular flap which is to be turned downwards in proceeding with the operation. The ligature of the axillary artery above the *pectoralis minor* muscle can be effected with much more facility by the double incision of Chamberlayne, than by the ordinary method, and is therefore preferable to it.

§ 2. *Ligature of the subclavian artery.*—A ligature may be applied to the subclavian artery at three different points in its course: 1st, on the *outside* of the *scaleni* muscles, upon the first rib; 2d, *between* the *scaleni*, behind the insertion of the *scalenus anticus;* 3d, *within* the

scaleni. In the first two of these operations the artery is sought for in the supra-clavicular triangle already described.

I. *On the outside of the scaleni.—Velpeau's method.*—1st, The patient being situated conveniently, a transverse incision is to be made above the clavicle, and parallel with its posterior border, extending from the sterno-mastoid muscle to the anterior edge of the trapezius. The skin, platisma, and cellular tissue are to be divided, layer by layer, and the external jugular vein, if it cannot be avoided, must also be cut across, after being tied above and below; 2d, the cellular and fatty tissue is now to be torn and pushed aside with the point of the director, until the finger can detect, at the bottom of the wound, the *tubercle on the first rib*, into which the scalenus anticus is inserted; 3d, this landmark being well recognized, introduce upon the finger the point of an artery needle, from before backwards, and slightly from without inwards, so that it may pass beneath the artery, preventing, at the same time, with the point of the finger, the artery from being pushed by the needle towards the first trunk of the brachial plexus. In order to facilitate this manœuvre, the shoulder should be depressed as much as possible.*

II. *Between the scaleni;—Dupuytren's method.*—This operation differs from the latter only in the situation of the ligature, which is to be placed on that portion of the artery which lies between the two scaleni muscles. To accomplish this, after the operator has recognized the situation of the tubercle on the first rib, and has felt distinctly the insertion of the muscle into it, he passes a director beneath the latter, between it and the artery, and on the director divides the muscle across. Thus, by the retraction of its muscular fibres, the artery is exposed, and a ligature is readily carried around it. The objections are urged against Dupuytren's operation: that in it the phrenic nerve, which lies along the inner margin of the *scalenus anticus*, is exposed to injury, as well as the subclavian vein, and the origin of the internal mammary artery, which lie in its immediate vicinity.†

* This operation was first performed by Mr. Ramsden, of St. Bartholomew's Hospital, London, in 1809; his patient died on the fifth day. It was first successfully performed by Prof. Wright Post, in this city, in 1817.

† The successful termination of this operation in Dupuytren's case, as well as more recently in the hands of Dr. J. C. Warren, of Boston, renders it desirable to obviate these objections if possible, especially as in some cases it may be substituted for the ligature of the artery within the scaleni, which is such a desperate resource. Prof. Mott proposes to avoid some of the dangers enumerated above, which, by the

III. *Within the scaleni.*—Colles, Mott, and Liston have each placed a ligature upon the artery in this situation, but thus far it has not been followed by success. The operation presents so many serious difficulties, on account of the great depth of the artery, its numerous branches, and the importance of the parts by which it is surrounded, that it is at present hardly considered a justifiable undertaking.*

way, are not alluded to by any of the surgeons who have successfully performed the operation, by cutting through the *scalenus anticus* muscle vertically, in the direction of its fibres, to a sufficient extent, and passing a ligature around the artery through the opening thus made.—Eds.

* The mode of operating adopted for the ligature of the *right* subclavian artery within the *scaleni*, is very much the same as that for the ligature of the *arteria innominata*, to be shortly described. A similar method was also employed by Dr. J. Kearny Rodgers, for the ligature of the *left* subclavian within the *scaleni*, an operation never before attempted until performed by him at the New-York Hospital in 1846. The result of the case was unsuccessful.—Eds.

Plate XI.

LIGATURE OF THE PRIMITIVE CAROTID, LINGUAL AND FACIAL ARTERIES.

FIG. 1, 2 AND 3. SURGICAL ANATOMY.

Fig. 1. *Origin of the carotid and subclavian arteries; branches of the subclavians.*—*a*, *a*, arch of the aorta; *b*, *innominata*; *d*, *c*, right subclavian and carotid, arising from the *innominata*; *e*, *f*, left subclavian and carotid. On the inner side of the *scalenus* muscle, *g*, on either side, the subclavians give off the following branches: the vertebral arteries, *h*, *h*; the inferior thyroid and supra-scapular, arising generally from a common trunk, the thyroid axis, *i*, *i*; the internal mammary arteries, *j*, *j*. Beyond the scalenus arise: the posterior scapular branches, *k*, *k*; and the acromio-thoracic artery, which, however, is more frequently given off by the axillary artery, just above the *pectoralis minor* muscle.

Fig. 2. *Relations of the arterial with the venous trunks.*—*a*, *a*, internal jugular veins, somewhat in front of and external to the carotids; *b*, *b*, the subclavian veins, in front of, running parallel with, and somewhat lower down than their corresponding arteries; *c*, the *vena innominata* in front, and a little on the outside of the artery of the same name; *d*, the left brachio-cephalic venous trunk, or *vena innominata*, crosses in front of the origins of the left subclavian and carotid, and the arch of the aorta; *e*, inferior thyroid vein; *f*, external jugular.

Fig. 3. 1, sterno-thyroid muscle; 2, omo-hyoid; 3, 3, extremities of the sterno-mastoid muscle, which has been cut across; 4, masseter.

A, *right primitive carotid.* Extending from the bifurcation of the innominata to the upper border of the thyroid cartilage, it ascends the neck somewhat obliquely from before backwards, and from within outwards, skirting along the outer side of the trachea and larynx, and lying upon the *longus colli* and *rectus anticus major* muscles. In its lower half it is covered in front by the sterno-hyoid and sterno-thyroid muscles, 1; near its middle it is crossed by the omo-hyoid muscle, 2; and below this point it is also overlaid by the sternal portion of the

Fig. 3.

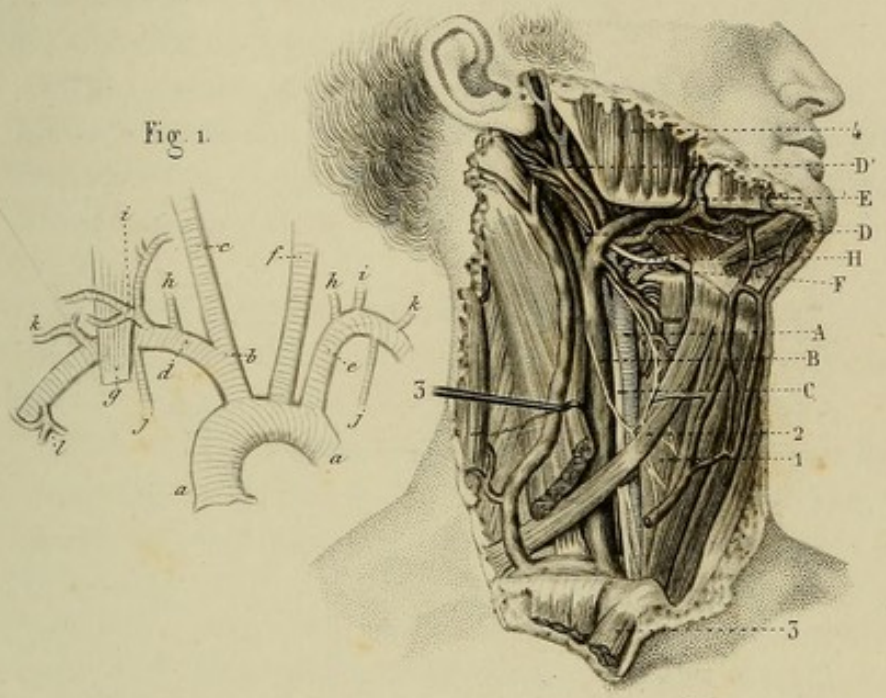


Fig. 1.

Fig. 4

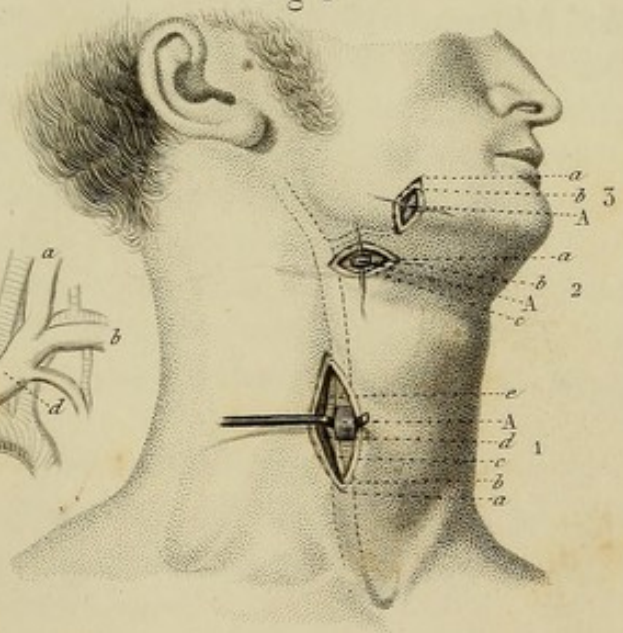


Fig. 2.



sterno-mastoid, by which it is separated from the platisma and integuments, the platisma covering the artery only in its upper half.

B, the *internal jugular vein*, which lies on the outside of the artery, and over-lays it slightly.

C, the pneumogastic nerve, which lies behind the vein and artery and between them, in the same sheath; below, it passes between the subclavian artery and vein to enter the thorax. Several cardiac branches arise from it, which cross in front of the artery in its lower fourth.

The *great sympathetic* nerve lies still further behind the vessels, in the loose cellular tissue between their sheath and the prœvertebral muscles, in company with some lymphatic vessels and glands.

D, the *internal carotid*, and D′ the *external carotid*, are the terminal branches of the primitive trunk. The external carotid, lying in front of the internal, terminates opposite the articulation of the lower jaw, where it takes the name of *temporal*. Almost superficial at its origin, it is immediately afterwards crossed by the *great hypoglossal nerve* H, and stylo-hyoid and digastric muscles, when it enters the substance of the parotid gland.

E, the *facial artery*, arising from the external carotid, a little above the *cornu* of the *os hyoides*, passes beneath the stylo-hyoid and digastric muscles, through the submaxillary gland, and by a flexuous course reaches the base of the lower jaw, over which it mounts, lying in the interspace between the *triangularis oris* muscle, and the anterior border of the masseter, whence it passes on to supply the face.

F, the *lingual artery*, arising from the external carotid below the facial, and opposite to the os hyoides, over which it winds to bury itself in the tongue. At its origin it is crossed by the *great hypoglossal nerve* H.

FIG. 4. OPERATIONS.

Incision No. 1. *Ligature of the facial artery.—a*, incision in the skin; *b*, edges of the platisma and deep fascia; A, facial artery, beneath which a ligature has been passed.

Incision No. 2. *Ligature of the lingual artery.—a*, incision through the platisma and deep fascia; *c*, incision in the genio-hyo-glossus muscle; A, lingual artery with the ligature beneath it.

Incision No. 3. *Ligature of the carotid in its middle portion.—a*, incision of the skin; *b*, deep cervical fascia; A carotid artery, with the director beneath it.

§ 1. *Ligature of the innominata.* This artery takes its origin from the most anterior point of the arch of the aorta, and after ascending obliquely from an inch to an inch and a half, terminates opposite to the right sterno-clavicular articulation. Although so short and deeply situated, this artery has nevertheless been tied in the living body, without excessive difficulty, by Mott, who employed the following steps in the operation.

Mott's method. 1st, The patient lying conveniently, with his head thrown backwards, an L shaped incision is made, the horizontal portion of which extends parallel with the clavicle, and about half an inch above it, from the median line of the neck three inches outwards, whilst the vertical portion follows the internal edge of the right sterno-mastoid muscle to the same extent.

2d. The whole of the sternal portion, and the greater part of the clavicular insertion of the sterno-mastoid muscle, is then cut across and turned over the flap, and the sterno-hyoid and sterno-thyroid muscles thus brought into view, are divided in the same manner, and turned over upon the trachea; 3d, the carotid being now recognized, is followed down to its origin; 4th, the *innominata* being laid bare to the necessary extent, carefully avoiding the pneumogastic and phrenic nerves, as well as the internal jugular vein and the pleura, pass the ligature in an appropriate artery needle, from below upwards, and from without inwards.

§ 2. *Ligature of the primitive carotid artery at the middle of the neck.* (Pl. 16, fig. 2). 1st, The patient being placed in a recumbent position, and the head turned to the opposite side, an incision three inches in length is to be made along the inner border of the sterno-mastoid muscle, and carried through the skin, subcutaneous cellular tissue, and *platysma myoides.* 2d, Divide upon a director that portion of the deep cervical fascia, which unites the edges of the sterno-hyoid and sterno-thyroid muscles, with the sterno-mastoid; 3d, flexing the patient's head forward, and separating the muscles just named, the omo-hyoid is brought into view crossing the wound obliquely, this may be pushed upwards, or downwards, or cut across, if in the way; 4th, the sheath of the vessel is now visible, this is to be opened with care, upon a director, whilst an assistant presses upon the vein at the upper angle of the wound, to prevent its extreme distention from interfering with the

operator; 5th, the cellular tissue connecting the vessels is then to be gently torn with the point of the needle, in order that it may be passed beneath the vessel, from without inwards.

Ligature of the primitive carotid at the base of the neck.—Malgaigne's method.—1st, Make an incision from two and a half to three inches in length, extending from a point one-third of an inch above the sterno-clavicular articulation, upwards in the direction of a line which, if produced, would meet the symphysis of the chin; 2d, the skin, cellular tissue, and deep cervical fascia being divided, the sternal insertion of the sterno-mastoid muscle is laid bare; 3d, divide this in the direction of the external incision, and beneath it will be found the sterno-hyoid and sterno-thyroid muscles, which are to be pushed inwards towards the trachea; 4th, the sheath containing the vessels is now in view, and it should be opened, in the usual manner, as near to the trachea as possible, in order to avoid the vein.

§ 3. *Ligature of the lingual artery.—Malgaigne's method.*—(Pl. 11, fig. 4.) 1st, Having recognized the position of one of the greater *cornua* of the hyoid bone, make an incision about an inch in length parallel with, and about two lines above it, through the skin, cellular tissue, and platysma; 2d, this incision will expose the lower border of the submaxillary gland, on lifting which slightly, the shining tendon of the digastric will be recognized; 3d, less than a line below this lies the great hypoglossal nerve, and at the distance of a line below the nerve, a transverse incision through the fibres of the *genio-hyo-glossus* muscle, will certainly expose the artery, which in this situation is accompanied by neither vein nor nerves.

§ 4. *Ligature of the facial artery as it crosses the lower jaw.*—(Pl. 11, fig. 4.) 1st, Let the patient close his jaws firmly, and feel with the finger for the anterior border of the masseter muscle, where the pulsations of the vessel can generally be distinguished; 2d, make over this point a vertical incision an inch in length, down to the fibres of the masseter; 3d, at its anterior edge the vessel will be found, resting immediately upon the bone, in company with its vein, the artery being nearer the median line. In isolating the artery the cellular tissue around it will be found to be somewhat dense.

Plate XII.

LIGATURE OF THE RADIAL, AND DORSALIS PEDIS ARTERIES.

FIG. 1. SURGICAL ANATOMY OF THE RADIAL ARTERY AT THE WRIST.

1. Posterior annular ligament of the carpus; tendons of the *extensor ossis metacarpi pollicis*, 2; *extensor primi internodii*, 3; and *extensor secundi internodii pollicis*, 4.

A, the radial artery (see pl. 7, fig. 1), opposite the radio-carpal articulation, winds around the styloid process of the radius to the back of the wrist, and passes beneath the united tendons, 2, 3, of the *extensor ossis metacarpi*, and *extensor primi internodii pollicis;* it then descends a little obliquely beneath the tendon of the *extensor secundi internodii pollicis*, and plunges through the first interosseous space of the metacarpus to the palm of the hand, where it terminates by forming the deep palmar arch.

In this course it is accompanied by its veins, and some small branches of the radial nerve; it is covered by the deep fascia of the limb, and the integuments.

FIG. 2. OPERATION.

a, incision in the skin; *b*, deep fascia; A, radial artery.

FIG. 3. SURGICAL ANATOMY OF THE ARTERIA DORSALIS PEDIS.

1. Anterior annular ligament of the tarsus; 2, tendon of the *extensor proprius pollicis pedis;* 3, tendons of the *extensor longus digitorum pedis;* 4, *extensor brevis digitorum pedis.*

A, the *arteria dorsalis pedis*, a continuation of the anterior tibial, commences beneath the anterior annular ligament of the tarsus, 1, midway between the malleoli, and extends to the commencement of the first interosseous space, where it passes directly downwards to the sole of the foot, and anastomoses with the plantar arch.

Covered by a layer of aponeurosis which binds it down upon the bones of the tarsus, and above this by the fascia of the limb, and the

Pl. 12.

Fig 1.

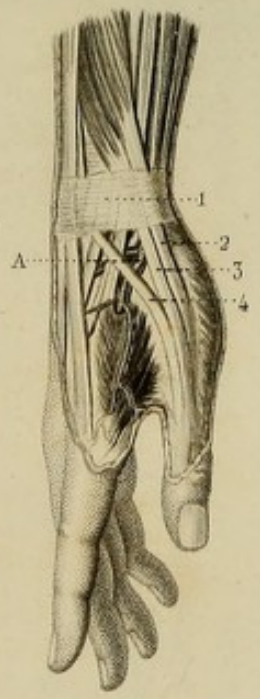


Fig 2.

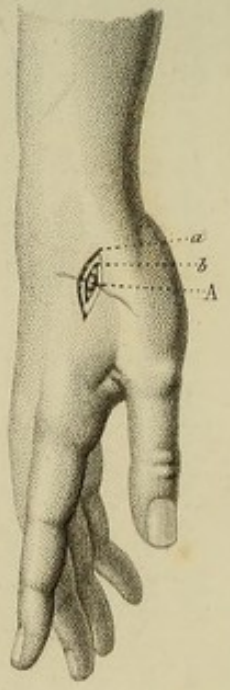
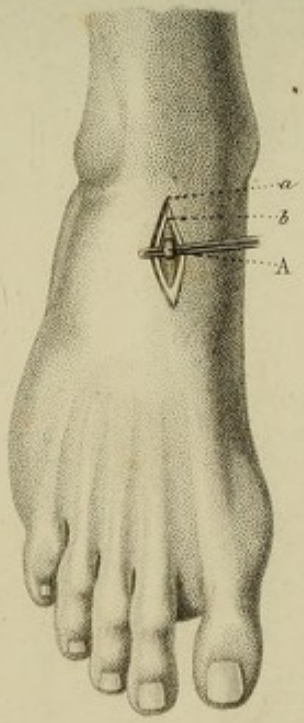


Fig 3.



Fig 4.



skin, the *dorsalis pedis* descends upon the instep, accompanied by its two *venæ comites*, and the anterior tibial nerve *b*, on its inner side. It runs along the outer edge of the tendon, 2, of the *extensor proprius pollicis*, an important relation, which offers an invariable guide to the artery by placing the great toe in the extended position. On its outer side it is in relation with the *extensor brevis digitorum pedis*, 4, which in muscular subjects overlays it to some extent.

FIG. 4. OPERATION.

a, incision in the skin; *b*, incision in the aponeurosis; A, *arteria dorsalis pedis* upon the director.

MODES OF OPERATING.

§ 1. *Ligature of the radial artery at the wrist.—Ordinary method.*—1st. By forced extension of the thumb determine the position of the tendon of the *extensor secundi internodii;* 2d, make an incision about an inch in length along the inner border of this tendon and parallel to it, the centre of which shall correspond to the proximal end of the first interosseous space; 3d, incise the deep fascia in a slanting direction; 4th, beneath this, in the angle at the extremity of the first interosseous space, the artery will be found lying upon the bone between its two veins; isolate it with the point of the director, and pass the ligature beneath it.

§ 2. *Ligature of the dorsalis pedis.*—1st, Make an incision about two inches in length about the middle of the instep, in the course of a line drawn from midway between the two malleoli to the upper end of the interosseous space, between the first two metatarsal bones, along the external border of the tendon of the *extensor proprius pollicis pedis*, and parallel to it; 2d, divide the deep fascia upon a director; 3d, endeavor to recognize the innermost division of the *extensor brevis digitorum*, and lay open the aponeurotic sheath of this muscle; 4th, beneath this, the artery will be found lying upon the bone, between its two veins, from which it is to be isolated and tied in the usual manner.

Plate XIII.

LIGATURE OF THE ANTERIOR TIBIAL ARTERY.

FIG. 1. SURGICAL ANATOMY.

1. Patella; 2, external malleolus; 3, external aponeurosis of the limb; 4 and 5, *tibialis anticus* and *extensor longus digitorum* muscles, separated by blunt hooks, exposing the vessels deeply situated between them; 6, *peroneus longus* and *brevis* cut across; 7, fibula.

A, the anterior tibial artery, the external and anterior branch of the popliteal, takes its origin beneath the tendinous arch uniting the two heads of the *solæus* muscle, and terminates in the *dorsalis pedis*, under the anterior annular ligament of the tarsus. Its direction, which is slightly oblique from above downwards and from behind forwards, would be represented by a line drawn from the centre of the space between the head of the fibula and tuberosity of the tibia, to the centre of the inter-malleolar space on the front of the ankle. The artery passes through the interosseous ligament in the upper fourth of the limb, to its anterior surface, and lies upon it in the upper two-thirds of its course; below this it lies upon the anterior face of the tibia. In the upper half of its course it lies deeply, between the *tibialis anticus* 4, and *extensor longus digitorum*, 5; in its lower half it is more superficially situated between the *tibialis anticus* 4, and *extensor proprius pollicis* 8, which latter muscle crosses it from without inwards, anteriorly, as it passes to its destination; the artery then skirts along the outer side of its tendon, and passes beneath the anterior annular ligament, in the same tendinous sheath.

The *extensor longus* and *tibialis anticus* muscles take their origin partly from the deep fascia in the upper part of the leg, 3, and this arrangement renders it difficult to recognise the intermuscular septum before dividing it freely, and also interferes with the ready separation of the muscles.

B, B, the *anterior tibial veins*, which accompany the artery throughout its course.

Pl. 13.

Fig. 1.

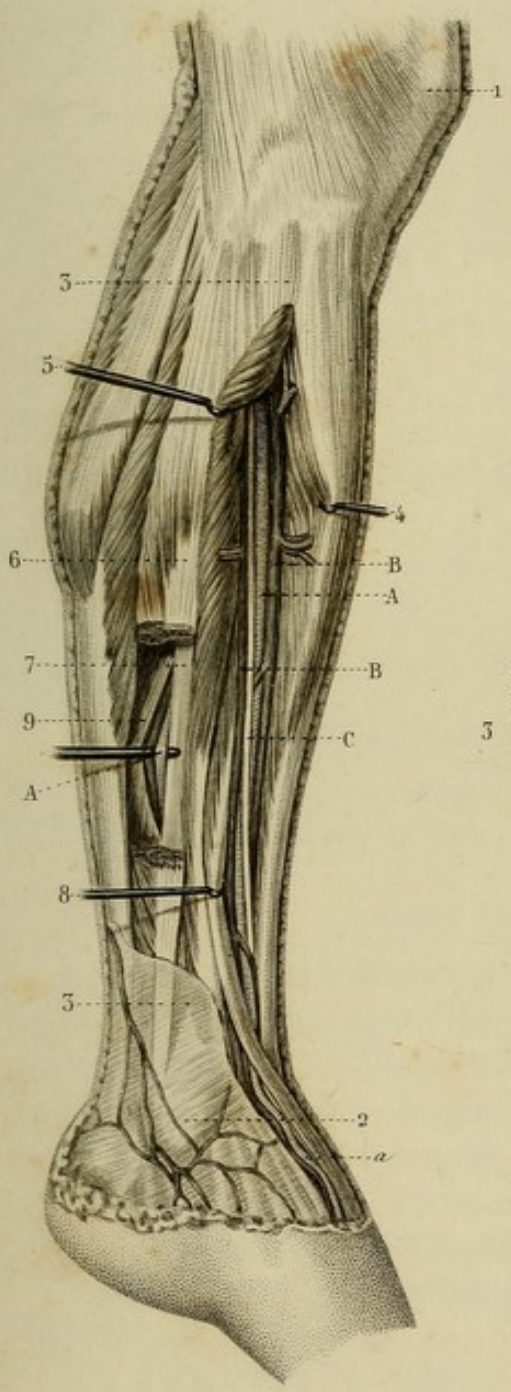
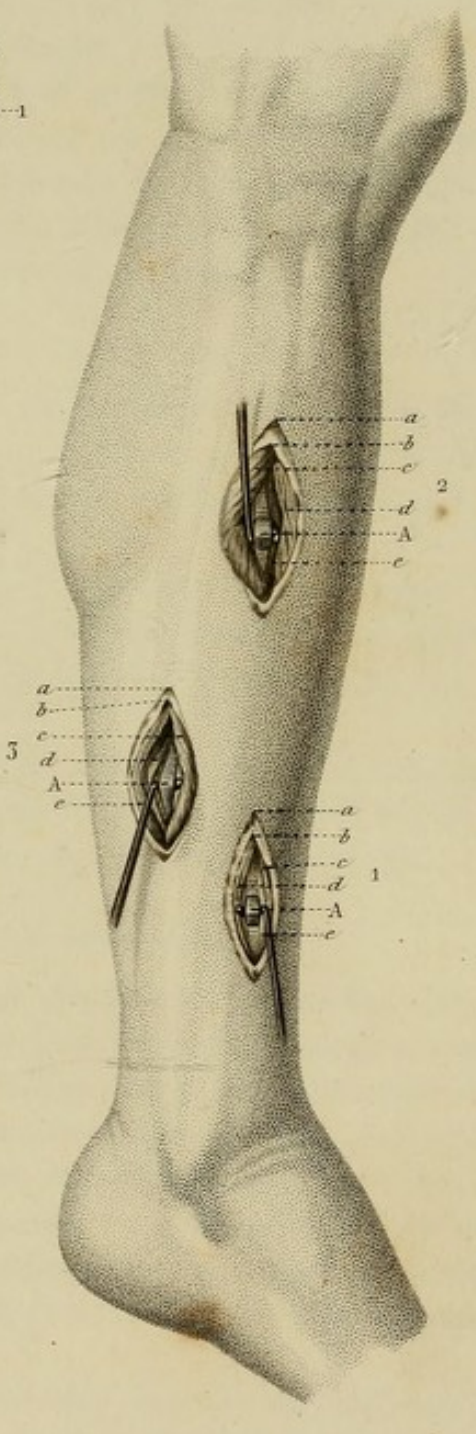


Fig. 2.



C, anterior tibial nerve; at first it lies external to the artery, afterwards crosses it in its lower fourth, and lies internal to it under the anterior annular ligament of the tarsus.

A′, the peroneal artery, the most external and posterior branch of the popliteal, runs down the posterior face of the fibula to the *os calcis*, covered above by the *solæus* muscle; lower down it lies between the *flexor longus pollicis*, 9, and the *tibialis posticus* muscles; and in its lower fourth lies upon the interosseous ligament.

FIG. 2. OPERATION.

Incision No. 1. *Ligature of the anterior tibial artery below its middle.*—*a*, incision in the skin; *b*, deep fascia; *c*, *tibialis anticus*; *d*, *extensor proprius pollicis pedis*; *e*, anterior tibial nerve; A, artery upon Deschamps' needle.

Incision No. 2. *Ligature of the anterior tibial in its upper half.*—*a*, incision in the skin; *b*, deep fascia; *c*, *extensor longus digitorum*; *d*, *tibialis anticus*; *e*, anterior tibial vein; A, artery with the needle beneath it.

Incision No. 3. *Ligature of the dorsalis pedis.*—*a*, incision in the skin; *b*, deep fascia; *c*, *peronæus longus*; *e*, external border of the solœus; *d*, flexor longus pollicis; A, artery upon the needle.

MODES OF OPERATING.

§ 1. *Ligature of the anterior tibial below its middle.*—1st, in the course of a line representing the direction of the artery, or, along the external border of the *tibialis anticus* muscle, the prominence of which can be generally recognised, make an incision through the integuments about three inches in length; 2d, lay open the deep fascia to the same extent upon a director; 3d, separate with the index finger the two muscles until the artery is recognised lying upon the tibia, in company with its two veins; 4th, separate it from its connections and apply the ligature with a needle.

§ 2. *Ligature of the anterior tibial in its upper half.*—1st, about ten lines to the outer side of the spine of the tibia, and in the course of a line drawn from the external tuberosity at the head of the tibia to the middle of the instep, make an incision through the integuments from three to three and a half inches long; 2d, the inter-muscular space being difficult to recognise, it is better to lay open the deep fascia by a crucial incision; 3d, the intermuscular septum will then be sought

for by the finger in the wound, and will generally be recognised by the diminished resistance which it offers; when found, the muscles are to be forcibly separated down to the interosseous ligament, upon which the artery will be found with the nerve lying in front of it, and a vein on either side; 4th, the artery being isolated, the ligature is to be passed beneath it by means of a needle.

§ 3. *Ligature of the peronæal artery below its middle.—Malgaigne's method.* Seek for the external border of the fibula, and about two lines behind it, and parallel with it, make an incision through the integuments from two and a half to three inches in length; 2d, divide the deep fascia to the same extent; 3d, the external border of the *solæus* muscle sometimes lies over the fibula, detach this gently and push it inwards; then, commencing from the external border of the bone, which should be fairly in view, detach from its posterior surface the attachments of the *flexor longus pollicis*, which takes its origin from its lower two thirds; 4th, push this muscle inwards, and at its inner border, near the insertion of the interosseous ligament, the artery will be found lying beneath a layer of the deep fascia derived from the investment of the muscle; having divided this, the artery will be found immediately beneath it.

Pl. 14.

Fig. 1.

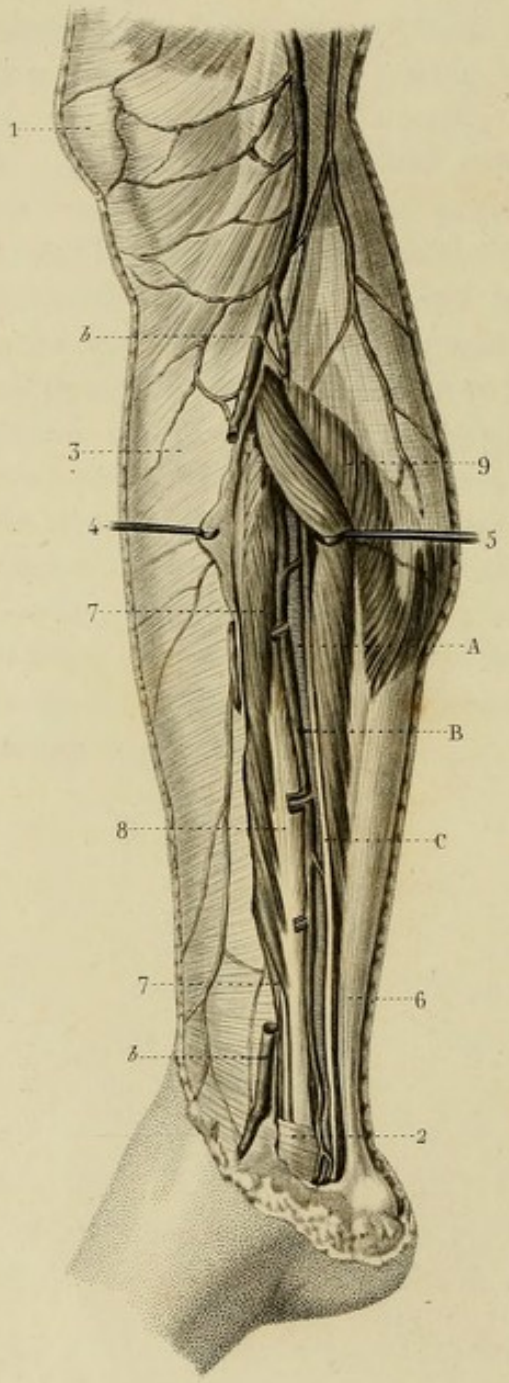


Fig. 2.

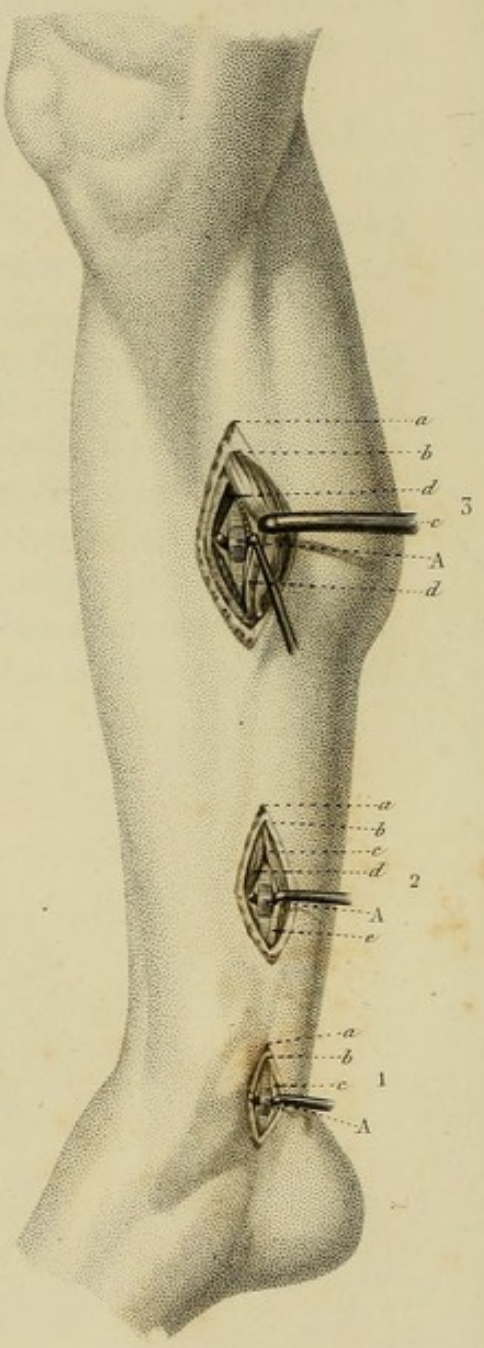


Plate XIV.

LIGATURE OF THE POSTERIOR TIBIAL ARTERY.

FIG. 1. SURGICAL ANATOMY.

1, patella; 2, internal malleolus; 3, internal surface of the tibia; 4, internal aponeurosis of the limb; 5, *solæus* muscles, pulled backwards by the blunt hook.

A, the *posterior tibial artery*, arises from the popliteal on the inner side, and terminates beneath the internal annular ligament of the tarsus, where it divides into the internal and external plantar arteries. Its direction, somewhat oblique from without inwards, would be represented by an imaginary line drawn from the middle of the popliteal space, and terminating behind the internal malleolus.

In its *upper third*, the *posterior tibial artery* is situated deeply beneath the *tibialis posticus*, 7, and covered also by the deep aponeurosis, 4, the *solæus*, 5, and the *gastrocnemius*, 9; in its middle third, it lies nearer the surface, running parallel with the internal border of the tibia, and separated from that bone by the *flexor longus digitorum* muscle, 8, and covered by the deep aponeurosis and the internal border of the *solæus*, 5; finally, in its lower third, lying immediately beneath the deep aponeurosis, it runs behind the tendons of the *tibialis posticus* and *flexor longus digitorum*, in relation posteriorly with the inner edge of the tendo Achillis, 6.

BB, the two venæ comites of the artery, which anastomose frequently with each other; 6, internal saphœna vein.

C, *the posterior tibial nerve*, lying external to, and behind the artery.

FIG. 2. OPERATIONS.

Incision No. 1. *Ligature of the posterior tibial, in its lower third.* —*a*, incision in the skin; *b*, deep fascia; *c*, posterior tibial nerve; A, artery on the director.

Incision No. 2. *Ligature of the posterior tibial in its middle third.* —*a*, incision in the skin; *b*, deep fascia; *c*, external border of the so-

lœus; *d*, flexor longus digitorum; *e*, posterior tibial nerve; A, artery on the needle.

Incision No. 3. *Ligature of the posterior tibial in its upper third.*—*a*, incision in the skin; *b*, deep fascia; *c*, gastrocnemius, carried backwards by a blunt hook; *d*, incision in the *solœus* muscle; A, artery with the needle beneath it.

MODES OF OPERATING.

§ 1. *Ligature of the posterior tibial artery in its lower third, or behind the malleolus.—Velpeau's method.*—About one-third of an inch behind the posterior border of the internal malleolus, make a semicircular incision through the skin only, of an inch and three quarters in length, with its concavity looking towards the malleolus; 2d, incise the aponeurotic layer beneath cautiously upon a director, carefully avoiding the sheaths of the tendons which lie immediately behind the malleolus; 3d, beneath the aponeurosis, and in front of the nerve, the artery will be found, between its accompanying veins.

§ 2. *Ligature of the posterior tibial in its middle third.*—1st, At the distance of three-quarters of an inch from the internal border of the tibia, or, in a line midway between the internal border of the tibia and the *tendo Achillis*, make an incision from two and and a half to three inches in length through the integuments; 2d, incise the deep fascia to the same extent, and push the edge of the *solœus* muscle out of the line of incision; 3d, divide the deep aponeurosis upon the director, when immediately beneath it, the artery will be seen, between its two veins.

§ 3. *Ligature of the posterior tibial artery in its upper third.—Malgaigne's method.*—1st, At the distance of two thirds of an inch from the internal border of the tibia make an incision at least four inches in length, through the integuments and deep fascia; 2d, carrying the index finger into the wound, detach and push outwards the internal head of the *gastrocnemius*, and divide also the attachments of the *solœus*, thus exposed, from the posterior surface of the tibia; 3d, whilst an assistant keeps this muscle held backwards and outwards with a blunt hook, divide the deep layer of aponeurosis upon a director, and search for the vessel immediately beneath it; 4th, detach the artery, and pass the ligature beneath it with the artery needle.

Manec's method. Instead of detaching the *solœus* muscle from the tibia, this author directs that it should be divided, throughout its entire thickness, about an inch from the internal border of the tibia; this

brings in view a thick, pearly, fibrous layer of tissue, into which its fleshy fibres are inserted, the anterior sheath of the muscle, which is perforated by several small arteries. Dividing this freely upon a director, the deep aponeurotic layer covering the artery is brought in view. In the first mode of operating it may happen in the living subject, as in the case of M. Bouchet of Lyons, that in consequence of the contraction of the muscles interfering with the operator, it might become necessary to cut across the *solæus* muscle. The object of Manec's method is to prevent the necessity of this step.*

* Mr. Guthrie proposes to substitute a perpendicular incision, six to seven inches in length, through the centre of the calf, for the ordinary modes of reaching the posterior tibial artery.—Eds.

Plate XV.

LIGATURE OF THE POPLITEAL ARTERY.

FIG. 1, 2, AND 3. SURGICAL ANATOMY.

Fig. 1. *View of the parts after removal of the integuments.* Superficial vessels and nerves.

1, 1. Deep fascia removed in the upper half of the popliteal region; 2, *semi-membranosus* muscle; 3, *biceps*; 4, cutaneous vessels and nerves; 5, internal saphœna vein.

A, *external, or posterior saphœna vein*; it runs perpendicularly, following the median line of the limb to the middle of the popliteal space, where it perforates the deep fascia; beneath the fascia it still ascends, and winds around the popliteal nerve, to empty into the popliteal vein. In the first part of its course, above the deep fascia, it is accompanied on its outer side by the *external saphœnous nerve, b*; it frequently overlays the nerve, and is separated from it by a process of the deep fascia which forms a separate sheath for the nerve.

C, popliteal nerve, lying immediately beneath the deep fascia, passes down the centre of the popliteal space, being situated superficial to, and a little on the outside of the popliteal vessels, from which it is separated by a thin layer of adipose tissue. It gives off several branches, of which the principal is the *external saphœnous nerve, b*, which, after running a short distance beneath the deep fascia, emerges through the same opening which transmits the external saphœna vein.

D, *the peroneal nerve*; more superficial and smaller than the preceding, it is given off from it, at an acute angle, in the upper part of the popliteal space, and descends obliquely from within outwards, beneath the deep fascia, to be distributed to the muscles on the outside and front of the lmib. In the popliteal space it gives off the *communicans peronei*, which is one of the roots of the external saphœnous nerve, and a branch, *c*, which pierces the deep fascia, and ultimately anastomoses with the external saphœnous nerve.

Fig. 2. *View after removal of the deep fascia.*—The popliteal

Pl. 15.

Fig. 2.

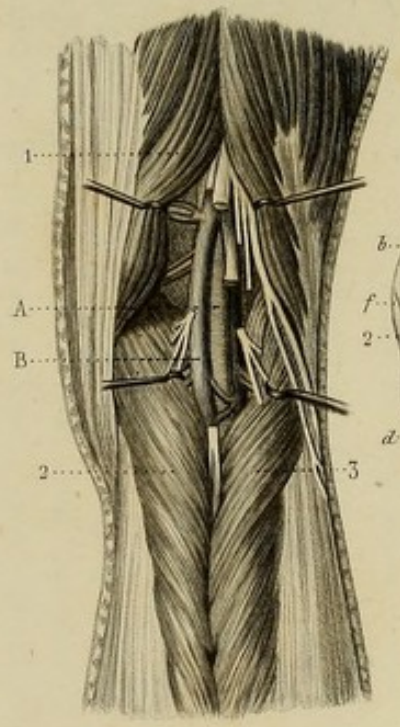


Fig. 3.

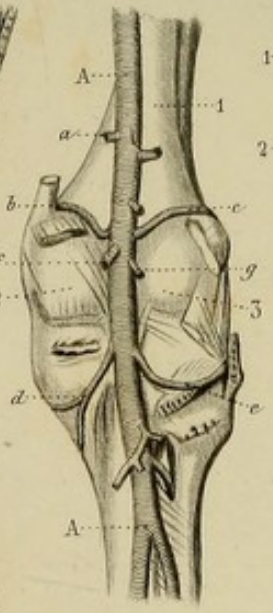


Fig. 1.

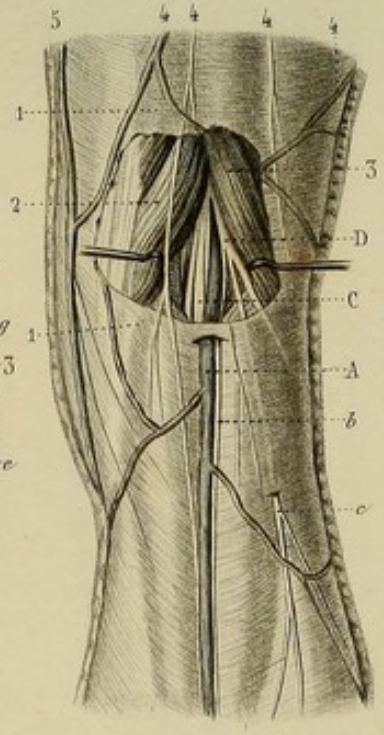
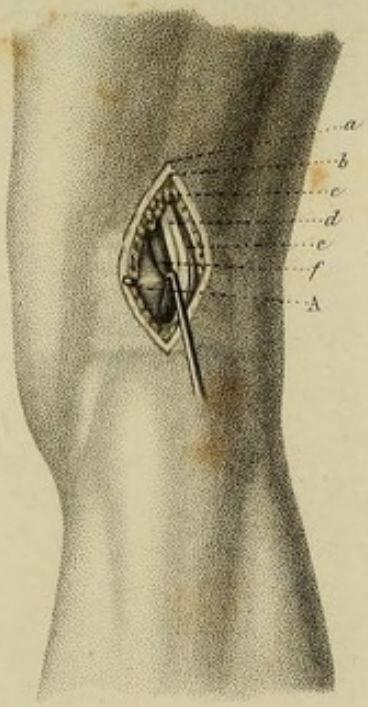


Fig. 4.



nerve being cut away in a part of its course, and the adipose tissue dissected out, the vessels are exposed to view.

A, the *popliteal artery*, extending from the tendinous opening in the *adductor magnus* muscle to the lower border of the popliteus, runs a little obliquely from within outwards, covered in its whole course, and crossed about the middle of the popliteal space, by the *popliteal vein*, B, whose direction is vertical; in consequence of this relation the artery, always beneath the vein, is somewhat internal to it above, and external to it below. The two vessels are covered superiorly by the belly of the *semi-membranosus*, 1; below they pass between the two heads of the gastrocnemius, 2, 3. They are connected together, throughout their course, by dense cellular tissue which renders their separation difficult.

Fig. 3. The *popliteal artery*, at first on the inner side of the femur, 1, afterwards approaches the centre of its posterior face, and passes downwards between the condyles, 2, 3, in contact with the articulation, 2. In its course it gives off several branches, of which the principal are: the *superior articular arteries*, *a*, *b*, *c*; the *inferior articulars*, *d*, *e*, which anastomose with the preceding in front of the knee; the *middle articular* arteries, which enter the articulation, and the *sural* arteries, *f*, *g*, which enter the gastrocnemius muscle.

FIG. 4. OPERATION.

Ligature of the popliteal artery in its superior half.—*a*, incision of the skin; *b*, deep fascia; *c*, adipose tissue; *d*, peroneal nerve; *e*, external saphœna vein; *f*, popliteal vein; A, artery upon the needle.

MODE OF OPERATING.

Ordinary method.—1st, the patient lying on his face with the limb extended moderately, make an incision from three to four inches in length through the skin and cellular tissue in the middle of the popliteal space, and in the dissection of the length of the limb; 2d, divide the deep fascia to the same extent upon a director, taking care to push the external saphœna vein to the outside; 3d, tear very carefully through the cellular tissue and fat, with the point of the director, at the same time flexing the leg slightly upon the thigh in order that the muscles may be separated with more facility; 4th, push the popliteal nerve, which is encountered first in the wound, to the inside; beneath this and a little to the inner side is found the popliteal vein, whose

connections are to be cautiously detached and the vein pushed also to the inner side, whilst the artery is sought for beneath it, in contact with the ligaments of the articulation.

The popliteal artery may also be tied, both in the upper and lower half of the popliteal space, by the following method, with this difference only, that in order to reach the artery *in its lower half*, the external incision must be made three and a half inches long, commencing half an inch below the articulation of the knee, and extending along in the centre of the interval between the two heads of the gastrocnemius muscle. To tie the artery *in the upper part of its course* (see fig. 4), above the condyles of the femur, an incision four inches in length is required, which should begin on the lower third of the thigh, at a point opposite to the commencement of the artery, near the external border of the muscular prominence bounding the popliteal space on its inner side, and terminate at the centre of the space, opposite to the articulation.

Marchal's method.—Here the operator proposes to tie the artery in its lower half, but in place of getting at it through the popliteal space, as heretofore, the incision is made on the inner side of the limb just below the internal condyle of the femur. To do this, the patient should be placed upon his back, the limb flexed and lying on its outer side, and the surgeon standing on its outer side; an incision three inches in length is then made obliquely downwards and inwards, hugging the internal edge of the inner head of the gastrocnemius, and four or five lines distant from the inner border of the tibia. The integuments being incised, and the internal saphœna vein kept out of the way, the inner head of the gastrocnemius is separated from the deep layer of muscles by introducing the finger into the wound, and breaking down its cellular adhesions, and at the same time bending the leg upon the thigh to secure relaxation of its muscles; in this manner the artery is soon reached, lying on the inside of the posterior tibial nerve, and surrounded by several veins; nothing more is required but to divide the lamina of deep fascia which lies over it.

Jobert's method.—Here the artery is tied in its upper part, but through the inner side of the thigh, just above the condyle, instead ot through the ham. The incision should be three inches long, and should correspond to the *vastus internus*, and the muscles which form the inner border of the popliteal space.

Pl. 16.

Fig 1.

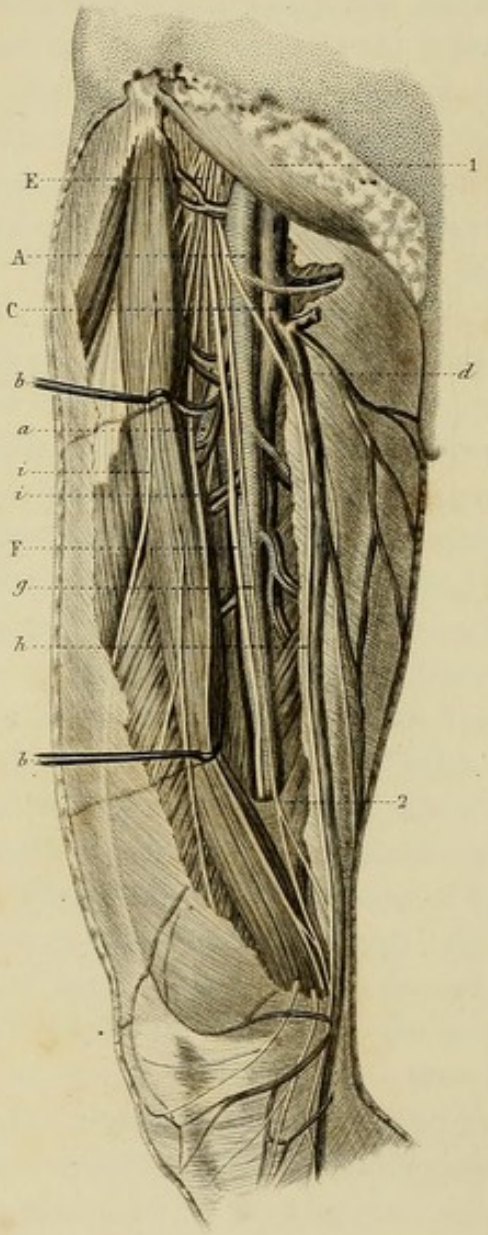


Fig 2.

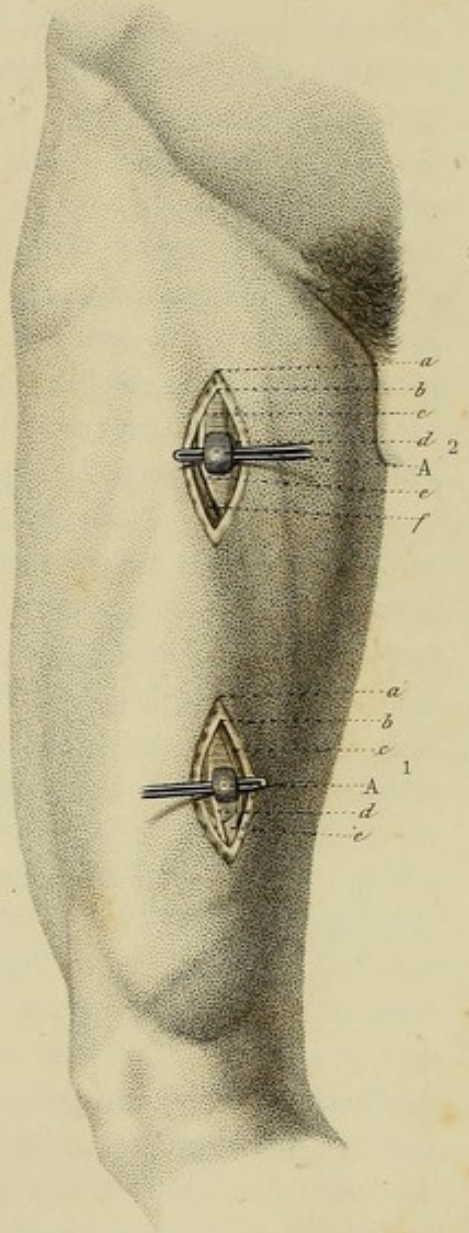


Plate XVI.

LIGATURE OF THE FEMORAL ARTERY.

FIG. 1. SURGICAL ANATOMY.

A, the *femoral artery*, the continuation of the external iliac, commences beneath the middle of the crural arch, formed by Poupart's ligament, 1, and terminates at the tendinous opening in the *adductor magnus* muscle, where it takes the name of *popliteal*. Its course is oblique, winding around the thigh in a spiral direction; at its commencement it is in front; in the middle of the thigh, on its internal side; and below, in the popliteal space, on its posterior aspect. In its upper fourth the artery is covered only by the lymphatic glands of the groin, the fascia lata, and the skin; here, its superficial position renders it easily compressible against the horizontal ramus of the pubes, or the head of the femur, which lie behind it. Lower down, the *sartorius* muscle lies between it and the integuments, crossing its track very obliquely, in such a manner that the artery corresponds with the internal edge of the muscle at one part of its course, and below, at the opening in the *adductor* muscle, with its external edge.

C, the *femoral vein*, accompanies the artery throughout its course; on its inner side, beneath Poupart's ligament; behind it, in the middle of the thigh; and behind, and a little to its outer side, below. The two vessels, which are connected by an unusually dense cellular tissue in the lower two-thirds of their course, are contained besides in a sheath given off by the fascia lata. The *internal saphœna vein*, *d*, which lies immediately beneath the skin, skirts along the internal edge of the *sartorius* muscle, and empties into the femoral vein of the saphœnous opening.

Æ, the *anterial crural nerve* lies on the outer side of the artery, and is separated from it by a layer of the iliac fascia.

The *long saphœnous nerve*, F, enters the sheath of the vessels, in their upper fourths, and runs down in company with them from this point, lying on the outer side of the artery; at the opening in the *ad-*

ductor magnus it crosses in front of the artery, and still lower down leaves it to accompany the internal saphœna vein. Another branch of the anterior crural nerve, *g*, lies in front of the femoral sheath, and from this a filament is given off, *h*, which passes across the vessels to join the internal saphœnous vein which it accompanies *i*, *i* ; musculo-cutaneous branches.

FIG. 2. OPERATION.

Incision No. 1. *Ligature of the femoral artery in its lower fourth.* —*a*, incision in the skin and subcutaneous cellular tissue; *b*, fascia lata; *c*, external edge of the *sartorius*, pushed inwards; *d*, long saphœnous nerve; *e*, the tendinous sheath of the femoral vessels; A, the artery, on the director.

Incision No. 2. *Ligature of the femoral artery in its upper third.*— *a*, incision through the integuments; *b*, fascia lata; *c*, sheath of the femoral vessels; *d*, femoral vein; *e*, saphœnous nerve; *f*, inner edge of the sartorius; A, artery upon the director.

MODES OF OPERATING.

§ 1. *Ligature of the femoral artery in its lower fourth, or at the opening in the adductor muscle.* (See fig. 2, incision No. 1.) 1st. The thigh being slightly flexed and rotated outwards, and the course of the artery being represented by a line drawn from the middle of Poupart's ligament downwards, and crossing the thigh obliquely inwards to the centre of the popliteal space, make an incision on this line,—or still better, if it can be recognised beneath the integuments, along the external edge of the *sartorius* muscle,—to the extent of three inches, through the skin and subcutaneous cellular tissue,—the centre of the incision corresponding to the union of the middle with the lower third of the thigh.

2d. Recognise with the finger the position of the *sartorius* muscle, and divide the fascia lata some two lines within its outer border; this will allow the muscle to be pushed inwards, and the posterior layer of its fascial sheath to be divided to the same extent. Then, feeling with the finger for the separation between the *vastus internus* and *adductor* muscles, divide carefully on a director the fibro-cellular layer which lies between them; this is the anterior wall of the canal formed for the passage of the artery, and after its division the vessel is brought in sight, with the vein behind it, and the nerve in front, and to its outer side.

3d. Separate very cautiously the dense cellular tissue by which the vessels are connected, and pass the needle from without inwards.

§ 2. *Ligature of the femoral at the middle of the thigh.*—1st, The limb being placed in the situation already described, make an incision on the course of the artery, at the middle of the thigh, following the internal edge of the sartorius muscle, and taking care not to wound the internal saphœna vein; 2d, push the *sartorius* muscle outwards until the sheath of the vessel, which lies beneath it, is brought into view; 3d, carefully lay open the sheath of the vessels upon a director; 4th, separate the vein from the artery, which is more easily effected at this point, and pass the needle from within outwards (see fig. 2, incision No. 2).

§ 3. *Ligature of the femoral in the upper third of the thigh, or in Scarpa's space.* In this method the object is to get at the artery near the apex of the triangle in which it lies in the upper third of the thigh, which is formed by the meeting of the *sartorius* and the *adductor brevis* muscles, its base being Poupart's ligament.

1st. At about four inches and a half below Poupart's ligament, the point where the artery begins to pass beneath the *sartorius* muscle, and where its pulsations become consequently somewhat less distinct, commence an incision three inches in length and carry it downwards along the internal edge of the *sartorius*. 2d, the *saphæna* vein, which lies in the cellular tissue beneath the skin, must be pushed inwards to avoid its being wounded, and some of the lymphatic vessels and glands are almost of necessity involved in the incision. 3d, the fascia lata being divided on the director, we come at once upon the artery in its sheath, lying along the inner border of the muscle, with the saphœnous nerve on its outer side, and the femoral vein within and behind it. 4th, the artery having been carefully isolated, pass the needle, or director, beneath it from within outwards.

Plate XVII.

LIGATURE OF THE FEMORAL ARTERY UNDER POUPART'S LIGAMENT, OF THE EXTERNAL ILIAC, AND EPIGASTRIC ARTERIES.

FIG. 1 AND 2. SURGICAL ANATOMY.

Fig. 1, 1. The external oblique, internal oblique and transversalis muscles with the integuments and aponeurotic layers which constitute the anterior wall of the abdomen, removed by dissection, leaving, 2, the peritonœum and fascia transversalis, concealing the convolutions of the intestines. The fascia transversalis furnishes an investment for the spermatic cord in the shape of an infundibuliform prolongation, 3; 5, Poupart's ligament, or crural arch; 6, fascia lata,—its cribriform portion removed to show the femoral vessels.

A, *femoral artery*; B, femoral vein; between the vein and artery a layer of fascia is seen, 7, which is the partition by which the femoral canal is divided into separate compartments. C, D, internal saphœna vein, with lymphatic vessels and glands.

A′, the epigastric artery, arising from the inner side of the external iliac, beneath Poupart's ligament. It passes beneath the spermatic cord, (beneath the round ligament in the female,) making a curve the concavity of which looks upward, and passes up obliquely from without inwards, between the peritonœum and fascia transversalis to the external edge of the rectus muscle, beneath which it is lost. 8, the two veins which accompany the artery.

Fig. 2. 1, section of the muscles of the abdomen at their insertion into the crest of the ilium; 2, anterior superior spine of the ilium; 3, fascia lata of the thigh; 4, psoas muscle; 5, iliacus internus muscle.

A, *aorta*; B, *right primitive iliac*; arising from the aorta at its bifurcation, opposite to the inferior border of the fourth lumbar vertebra, it descends obliquely outwards to the sacro-iliac symphysis, where it divides into the *external iliac artery*, *C*, and *the internal iliac*, D.

The *external iliac* C, continues in the direction assumed by the primitive iliac until it arrives beneath Poupart's ligament, so that the

Pl. 17.

Fig. 1.

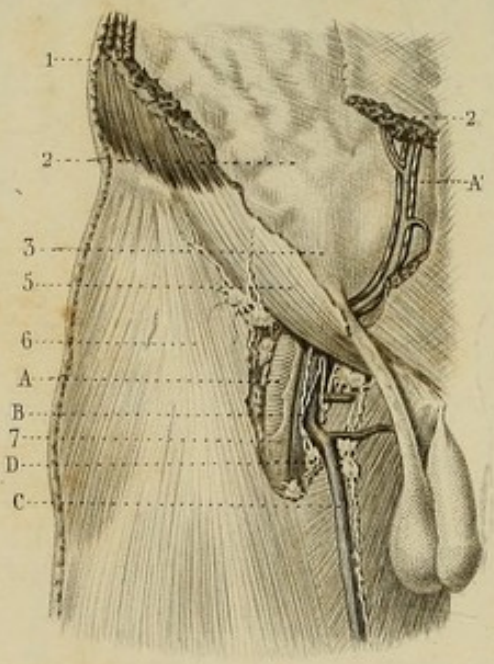


Fig. 2.

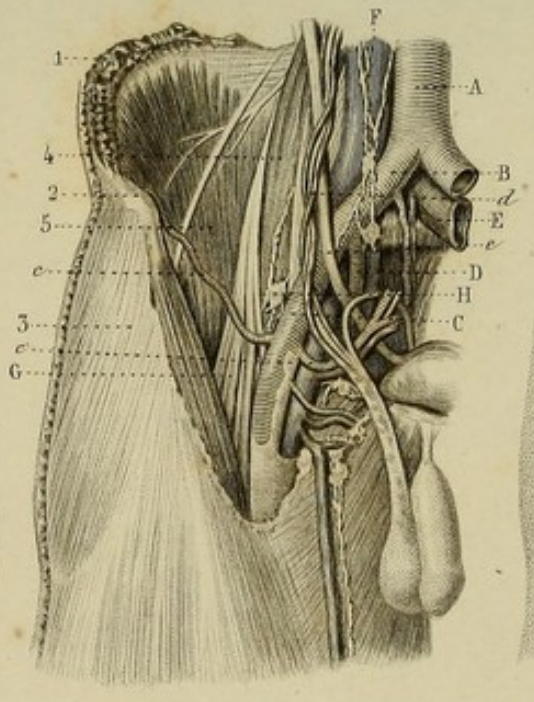
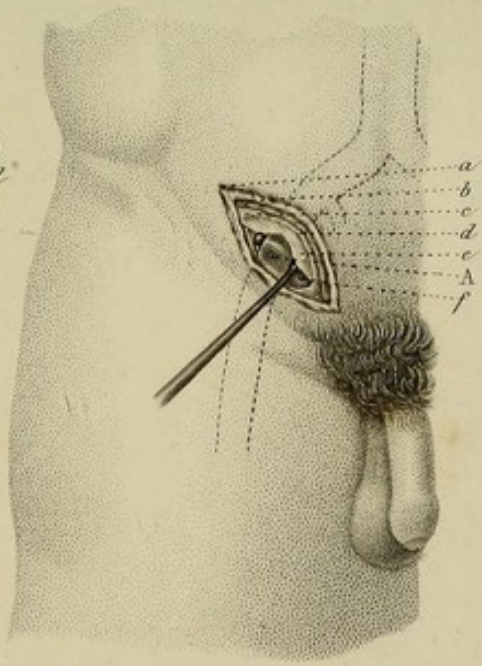


Fig. 3.



two arteries together form almost a straight line, resting above upon the vertebral column, and lower down upon the psoas muscle, 4; the external iliac artery, whilst passing beneath Poupart's ligament, gives origin on its outer side to the circumflex iliac artery, *c*, and within, to the epigastric, *c'*.

The internal iliac, or hypogastric artery, D, diverges from the preceding at an acute angle, and passing downwards into the pelvis is distributed to the organs contained in that cavity.

At their point of origin at the sacro-iliac symphysis, the *iliac arteries* are crossed by the *ureter*, *e*, and the *spermatic vessels*, *d*.

E, the *iliac veins*, situated at first on the inner side and behind the arteries, unite to the right of the bifurcation of the aorta to form the *inferior vena cava*, F.

The left iliac vein, at first in contact with its artery, towards its termination crosses behind the right iliac artery, in order to form a union with its fellow of the opposite side.

G, *anterior crural nerve*. H, H, *lymphatic vessels and glands*.

FIG. 3. OPERATION.

a, incision in the skin; B, C, D, divided edges of the muscles and fascia of the anterior abdominal walls; *e*, peritonœum detached and pushed upwards; *f*, external iliac vein; A, external iliac artery, with the needle beneath it.

MODES OF OPERATING.

§ 1. *Ligature of the femoral artery beneath Poupart's ligament.*—1st, beneath the centre of a straight line drawn from the anterior superior spine of the ilium to the symphysis pubis the pulsations of the femoral artery can be readily felt, as it is here very superficial. 2d, make an incision commencing immediately over Poupart's ligament, and extending two inches downwards in the course of the vessel; this incision will involve the skin, subcutaneous cellular tissue, and some lymphatic vessels and glands which it is impossible to avoid. 3d, divide with care, upon the director, the sheath of the vessels, beneath which the artery will be found, with the nerve on its outer side and the vein within, but separated from each by a process of fascia, (see fig. 1–7). 4th, separate the artery from its connections, and pass the needle from within outwards.

§ 2. *Ligature of the external iliac artery.*—The patient lying upon his back with the muscles of the abdomen in a state of relaxation, make

an incision three and a half inches in length, just above Poupart's ligament, and parallel with its general direction, but in a curved line, with the convexity downwards. The first stroke of the knife through the skin and superficial fascia divides sometimes the superficial epigastric artery, the cut ends of which should be tied before proceeding farther. The aponeurotic expansion of the external oblique should then be carefully divided, and afterwards the internal oblique and transversalis to the same extent. The finger should now be carried along the spermatic cord into the internal ring, and the fascia transversalis pushed upwards and outwards, taking great care not to injure the peritonœum. If at this stage of the operation the artery cannot be recognised by the eye at the bottom of the wound, the finger should be employed to ascertain its exact position, and then, with the point of the director, the sheath of the vessels furnished by the *fascia iliaca* should be cautiously torn through, and by the same means the artery should be separated from the vein and the nervous filament which accompanies them, and the needle inserted beneath it from within outwards.*

§ 3. *Ligature of the epigastric artery.*—The incisions employed in the ligature of the preceding artery may be applied to the epigastric, only they should not be so extensive. When the spermatic cord is brought in view, let it be lifted up so as to expose the inner border of the internal ring, through which it is about entering the cavity of the abdomen. Dilate the ring by introducing the point of the finger, and immediately behind the layer of transversalis fascia, which constitutes its internal border, the pulsations of the artery will be felt.

§ 4. *Ligature of the internal iliac artery.—Stevens' method.*—1st. Make an incision from four and a half to five inches in length, half an inch on the outer side of the epigastric artery and parallel with it. 2d. Having divided successively the integuments and abdominal muscles, detach the peritonœum with the utmost care from the psoas and iliacus muscles, and push it gently inwards and upwards until the bifurcation of the primitive iliac can be distinguished. 3d. Feel for, and isolate the artery with the index finger, and pass the ligature beneath it.

A similar process may be employed for the ligature of the *primitive iliac artery.*†

* This operation was first performed by Abernethy, in 1796.

† The *primitive iliac artery* may be tied by means of an incision similar to that employed for the ligature of the external iliac, but carried upwards and outwards to the extent of from five to seven inches. The external iliac being recognised as

§ 5. *Ligature of the gluteal artery. Robert's method.*—The patient lying upon his face, ascertain in the first place the position of the top of the great trochanter and the posterior superior spine of the ilium. 2d. Make an incision three inches in length, commencing an inch below the posterior superior spine of the ilium, and an inch to the outer side of the sacrum, and descending obliquely towards the top of the great trochanter. 3d. The incision having been carried successively through the skin, cellular tissue, and the fibres of the *glutæus magnus* muscle, the artery will be found lying immediately below the upper edge of the great sciatic notch. 4th. Separate the *pyramidalis* and *glutæus medius* muscles, which tend somewhat to conceal the artery, isolate it, and pass the ligature.

above, it is followed upwards, the peritonæum being very cautiously detached and raised in the same direction until the common iliac trunk is brought in view. The ligature is then passed beneath it, with the aid of the American artery needle, from within outwards, carefully avoiding the ureter.

This operation was first successfully executed in this manner by Mott, in 1827. It has been performed in all, fourteen times, at least six of which were successful. —Eds.

AMPUTATIONS

THROUGH THE JOINTS, OR DISARTICULATIONS.

When it becomes necessary, from one of the various causes, which it is not required to enumerate in this place, to remove a limb, or a part of a limb, by amputation through one of its joints, it is requisite: 1st, to recognize accurately the situation of the articular surfaces; 2d, to divide the parts which unite them by cutting across the articulation; 3d, to manage the incisions through the soft parts surrounding the articulation in such a manner that enough of them shall be left to cover the stump fairly, in order that cicatrisation may take place without difficulty.

§ 1. *General rules for determining the position of a joint.*—Around the extremities of almost all the bones which articulate with other portions of the skeleton certain bony prominences, or *tuberosities*, are distinguishable beneath the skin. These tuberosities, situated at variable distances from the joint, always bear to it accurate and unvarying relations, and are therefore sure guides to the surgeon. To recognize them with facility, the following mode of examination should be adopted: 1st. Commence always with that which is the most prominent and well marked, and having recognized its exact position and relations, the other smaller and less distinct projections will be more readily made out. 2d. To do this to the best advantage, place the limb to be examined in a convenient position, and from time to time, as required, give the joint all its natural motions in succession, and thus the bony prominences around it will be rendered more evident, and the tendons, or ligaments, attached to them, will be thrown more or less into relief.

We generally find also around the articulations *wrinkles*, or *creases in the skin*, the position of which is sufficiently constant to serve as indications to the surgeon of the situation of the joint. These folds in the skin, which are particularly well marked around the joints of the fingers, are sometimes found lying immediately over the articulation, at others again at a constant distance from it.

It might happen, however, that an accumulation of fat, or serum, around a joint, should mask the bony prominences, and efface the

wrinkles in the skin; or that a painful disease in its vicinity should render it impossible to give the joint its natural motions. In such a case we should endeavor to recognize the parts, as far as possible, by searching along the shaft of the bone towards its extremity with the finger, and then, if absolutely necessary, cut in the probable situation of the joint, making an appropriate flap, and feel in the wound for its exact position; failing in this search, the heel of the knife, applied perpendicularly to the bone, should be carried up and down its surface, in the probable situation of the joint, until its edge enters between the articular surfaces.

§ 2. *Rules for cutting through an articulation.* To traverse an articulation without hesitation, in the midst of the blood and soft parts which frequently mask the articular surfaces, the operator should have the disposition of the joint so fixed in his mind, that he could trace it out exactly without having it under his eye. It is no less necessary that he should be familiar with the exact situation, size and attachments of its ligaments, in order to recognize and cut through them without delay.

According to Lisfranc, knives for disarticulations should be narrow in the blade, in order that they may be readily turned in a joint, and thick in the back to ensure sufficient strength.

These points settled, we proceed to the operation of disarticulation, keeping in mind the following general rules:

1st. The thumb and index finger of the left hand should be applied one on either side of the joint, for the purpose of defining its exact position, when ascertained, and of guiding the knife accurately.

2d. When an articulation is to be entered from its anterior aspect, it should be held in the extended position; when on the contrary, the knife is applied to its posterior surface, the limb should be semi-flexed, in order to increase the distance between the articular surfaces.

3d. The principal ligaments of the joint should be divided at first. The lateral and dorsal ligaments being severed, the knife can generally be carried between the articular surfaces. But if the joint present several irregular surfaces for articulation, what are denominated *interosseous ligaments* may exist, passing from one bone to the other, within the joint; these require to be divided with the point of the knife before it can be fairly entered.

4th. When the articulation has been thus opened, it is in general sufficient to make gentle traction on the distal portion of the limb, in

the direction of its axis, in order to separate the articular surfaces enough to allow the knife to be passed between them. If the joint is too close and tight for this manœuvre to succeed, the articular surfaces must be partially dislocated, always, however, employing great care that no violence be done to the neighboring soft parts. Finally, if any ligaments should prove to be ossified, they must be divided by the saw.

5th. When the knife has fairly entered the articulation, its heel and point should act in the same plane, and if, whilst it is being carried around the articular surfaces to the opposite side of the limb, the integuments from which the flap is to be formed should be in danger of being cut irregularly, they should be drawn out of the way by the thumb and index finger of the hand which supports the articulation.

§ 3. *Of the mode of operating.*—The manner of making the incisions in the soft parts to provide a covering for the stump, depends upon the kind of operation selected. For all amputations of the limbs there are three principal forms given to the wound. In the first, the soft parts are all divided by a *circular* incision around the limb, and the cut surface is afterwards covered by the integuments only, which, before the section of the muscles, are turned up like the cuff of a sleeve. In the second, the part to be removed is circumscribed by an elliptic incision, which, after the operation is finished, leaves a wound, the edges of which are easily brought in contact, and whose shape gives the name to this style of amputation of the *oval* method. Finally, in the third mode, one or more flaps are fashioned out of the soft parts in its vicinity for the purpose of covering the extremity of the amputated limb; and to this process the name of *flap* operation is applied. To each of these general methods belongs a variety of operative procedures; all of which result, however, in the production of a stump bearing the characteristics either of the *circular*, *oval*, or *flap* operation. Thus, then, the general method indicates the character of the result aimed at, and the modes of operating, the different means by which this result is attained.

§ 4. *On the formation of flaps.*—1st. One, or several flaps may be made, according to circumstances. In the latter case, the least important flap should be made first, and that containing the larger vessels should be left until after the separation of the bones is completed, in order that, if necessary, they may be seized and compressed by an assistant before their final section.

2d. The flap should terminate by a curved line, and not by a point,

and to effect this, the knife must be carried along freely and without hesitation, parallel with the bone, until, by bringing it in contact with the surface it is intended to cover, it is found to be of sufficient length, when turning the edge of the knife directly outwards, the tissues are cut through square and clear. If the tendons project beyond the skin, they should be cut off with the scissors.

3d. Healthy tissues should be selected as much as possible for the formation of flaps; nevertheless, if necessary, they may be made from inflamed or infiltrated parts, as by judicious management this swelling will diminish under the suppurative process without much danger of gangrene. Finally, according to Lisfranc, a disarticulation may be undertaken where there are no soft parts from which to form a stump, experience having proved that a sound cicatrix will be formed over the articular surfaces.

Plate XVIII.

DISARTICULATION OF THE LAST TWO PHALANGES OF THE FINGERS, AND OF THE WHOLE FINGER.

SURGICAL ANATOMY.

Fig. 1. *Bones of a finger in their natural relation, seen on their palmar aspect.*—*a*, inferior extremity of the metacarpal bone; *b*, first phalanx; *c*, head of the first phalanx; *d*, second phalanx; *e*, third phalanx.

The phalangeal articulations are all perfect ginglymoid joints, that is to say, they allow but of two motions, flexion and extension. The head of the first phalanx presents two condyles separated by a groove; these fit into the two corresponding cavities in the second phalanx, which have a ridge between them. Each phalanx presents, also, near its articular surfaces, decided bony projections, both on its palmar and dorsal aspect, (Fig. 1, *c*, *c*; fig. 2, *e*.); two lateral ligaments give the articulations almost all their firmness. The extensor tendon behind, and a ligament in front, of little strength, complete the ligamentous apparatus of each joint. The interarticular line, the direction of which is almost transverse, of the articulation of the first with the second phalanx, is exactly opposite the fold of the skin on its palmar surface, and in the articulation of the second with the third, it is a line and a half below its corresponding fold.

Fig. 2. *Vertical section of the bones of a finger, showing the relations which the lines of the articulations bear to the folds of the skin.*—*a*, inferior extremity of the metacarpal bone; *bb*, line of the metacarpo-phalangeal point, to be found, in the normal state, about twelve or thirteen lines above the commissure of the fingers, *c*; *dd*, inter-articular line between the first and second phalanges, situated exactly opposite the fold of the skin; *ff*, inter-articular line between the second and third phalanges, situated a line and a half below the fold of skin on the palmar surface of the finger.

Fig. 3. *Relation of the flexor tendons to the bones of the finger.*—

Pl. 18.

Fig. 1.

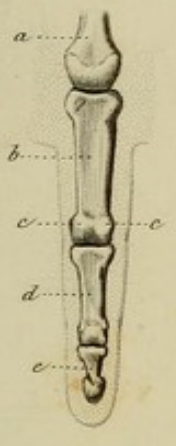


Fig. 2.



Fig. 3.



Fig. 4.



Fig. 10.

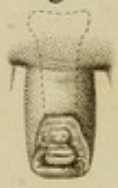


Fig. 5.

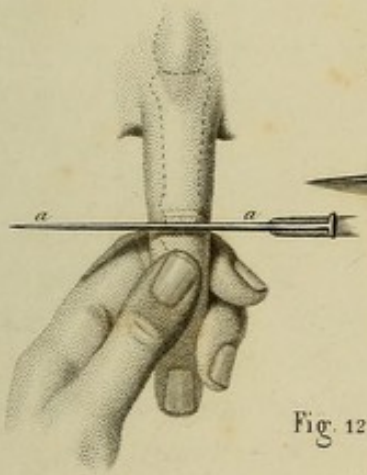


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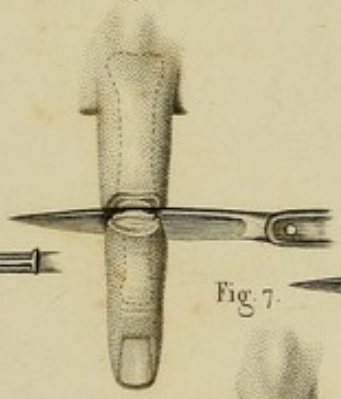


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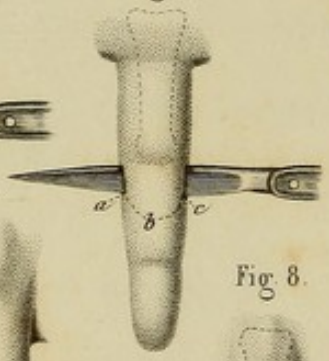


Fig. 7.

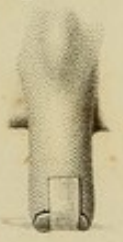


Fig. 8.



Fig. 12.

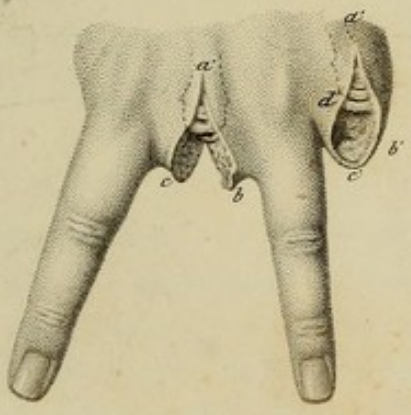
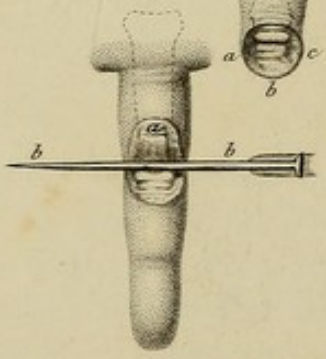


Fig. 11.



a, *a*, *a*, dorsal aspect of the articulations; *b*, tendon of the *flexor digitorum sublimis perforatus*; *c*, tendon of the *flexor profundus perforans*.

Fig. 4. *View of a finger in a state of flexion, showing the relation of the articular surfaces of the phalanges to each other when flexed.*

OPERATIONS.

Fig. 5. *Disarticulation of the second phalanx (finger); from the dorsal aspect of the joint.* 1st, *Lisfranc's method.*—1st, the edge of the bistoury *a*, *a*, about to enter the articulation.

Fig. 6. Same operation. 2d, after having cut through the articulation, the bistoury is brought beneath the second phalanx, for the purpose of cutting out a flap from its palmar surface.

Fig. 7. Operation finished; flap brought up into its place, and retained there by a strip of adhesive plaster.

Fig. 8. A modification of the preceding method. (*See modes of operating*).

Fig. 9. *Disarticulation of the second phalanx; from the palmar aspect of the joint. Lisfranc's second method.*—*a*, *b*, *c*, shape to be given to the palmar flap.

Fig. 10. Operation completed.

Fig. 11. Same operation after the bistoury *b b* has entered the joint, the flap being turned upwards.

Fig. 12. *Disarticulation of the entire finger.*—*a*, *b*, *c*, wound left after the operation with two flaps; *a' b' c' d'*, wound left after the operation by the oval method.

MODES OF OPERATING.

§ 1. *Amputation of the finger between the first and second phalanges. Circular method.*—The hand being placed in the state of pronation, an assistant should confine all the fingers in a flexed position except the one about to be operated on. Then the operator, holding the finger in an extended position with the thumb, index and middle finger of his left hand, makes a circular incision around it with the bistoury held in the first position, one-third of an inch below the articulation for the second phalanx, and one-fourth of an inch for the last phalanx. This incision being carried through the skin and cellular tissue, the assistant, by a suitable amount of traction, drags up the in-

teguments as far as the articulation, so that the surgeon can cut through it by dividing its ligaments, entering his knife on its dorsal aspect.

Flap Operations.—Ledran's method by two lateral flaps, and Garangeot's operation, with a dorsal and a palmar flap, are at present out of use, the operation with a single flap having been almost entirely substituted for them.

Lisfranc's first method, or disarticulation from the dorsal aspect of the joint.—An assistant supports the hand well pronated, and confines the sound fingers, keeping them as far as possible out of the way of the operator. The surgeon then takes the phalanx to be removed between the thumb and index finger of his left hand, (fig. 5,) and bends it to an angle of 45°; then, with a straight bistoury held in the first position, (pl. 1, fig. 1,) he enters the articulation on its dorsal aspect, cutting perpendicularly, a line and a half from the top of the inclined plane formed by the semi-flexed phalanx, or on a level with the fold in the skin on the palmar aspect of the joint for the second phalanx, and a line and a half below the corresponding fold for the first phalanx. At the same time that it penetrates the joint, the bistoury, carried from heel to point, should form a little semi-circular flap on its right and left sides, and the lateral ligaments should be divided as the blade enters between the articular surfaces, (fig. 6.) The phalanx should now be grasped by its sides, and the knife carried around its head to its palmar surface, along which it should be carried towards the operator, to a distance of four lines, in order to make a semi-circular flap of suitable size to cover the stump.

Fig. 7. In cutting the lateral ligaments of the articulation, care must be taken not to nick the base of the flap. The condyles of the first phalanx sometimes project on either side through the wound. To obviate this, the dorsal incision should be made as much of a curve as possible, with its concavity looking downwards, especially towards its lateral extremities.

Fig. 8. *Lisfranc's second method, or disarticulation from the palmar aspect of the joint.*—The hand is to be held in the position of forced supination by an assistant, who confines all the fingers in a flexed position, except the one about to be operated upon. The surgeon grasps the phalanx to be removed with the thumb and finger of his left hand, and in order to avoid wounding himself with the point of the bistoury, he should grasp it in such a manner that his thumb is applied upon the palmar surface of the phalanx at its distal end, and

the second phalanx of his index finger should cross its dorsal surface at right angles. The operator, then, holding a sharp-pointed bistoury in his right hand, in the first position, (pl. 1, fig. 2), with its blade flatwise, and its edge towards him, enters its point a line and a half below the fold of skin opposite the joint for the third phalanx, and exactly in a line with it for the second phalanx. It is then carried through the finger directly from one side to the other, in front of the articulation, and in contact with the bone, so as to take up as much upon the blade as possible, (fig. 9.) In this manner, the blade is introduced up to its heel, and then, by alternate motions, its edge being kept close to the bone, it is carried down along its palmar surface to a distance of half an inch, and then made to cut its way out, forming in this manner a semicircular flap, which is immediately carried upwards by the assistant. The edge of the bistoury is then applied perpendicularly to the joint and carried directly through it, dividing its ligaments and the integuments on the opposite side of the joint without making any posterior flap. Nevertheless, if it is feared that the posterior integuments should retract to too great an extent, their section can be effected a line or two below the articulation.

After the description of these two modes of operating, it can readily be understood, without any further details, how, in varying cases, arising from injuries or otherwise, *two flaps of the same size* could be made, one from the dorsal and the other from the palmar aspect of the finger; or, *a dorsal flap*, somewhat shorter than the palmar one; or, even *lateral flaps* of varying proportions. The rules already laid down for the disarticulation of the phalanges of the fingers are also applicable to the removal of the second phalanx of the thumb, which corresponds with the third phalanx of a finger—(Lisfranc.)

§ 2. *Disarticulation of an entire finger*, (fig. 12.) *Method by double flaps. Lisfranc's mode of operating.*—The hand being held in a state of pronation, and the fingers, except the one about to be operated upon, confined on either side by an assistant, the surgeon, before commencing the operation, should endeavor to recognize as accurately as possible the situation of the metacarpo-phalangeal articulation. To do this, it is to be borne in mind that the joint usually lies about an inch above the commissure between the fingers. Another method recommended by Malgaigne, and to which the operator can have recourse, especially when the parts are deformed by injury or otherwise, consists in applying strong traction to the finger whilst the metacarpus is held

firmly, by which means the articular surfaces are drawn apart one or two lines, and a depression, manifest to both sight and touch, is the result of the separation, indicating with exactness the situation of the joint. This being ascertained, the operation is to be effected in the following manner :—

1st. The first phalanx of the finger to be removed, is to be grasped by its dorsal and palmar surfaces, and flexed to an angle of 45°. With a straight bistoury, having a prominent heel to its blade, the surgeon commences an incision over the articulation above the head of the metacarpal bone, starting from the union of the internal two-thirds of the interarticular line with its external third, if he is operating upon the left hand, and *vice versâ* for the right hand, and carrying it down to the end of the commissure between the fingers. This incision, made by drawing the bistoury towards himself, and from heel to point, should divide at once all the soft parts down to the bone. Having attained the end of the web between the fingers, the blade of the bistoury should be brought to a perpendicular position, lying flatwise against the side of the phalanx, and then, at the same time that the hand of the patient is elevated so that the operator's eye shall precede the edge of the bistoury, he depresses its handle towards the palm of the patient's hand, whilst the heel of the knife is making an oblique incision on the palmar aspect of the joint similar to that on its dorsal surface.

2d. By the process just described, a lateral semi-circular flap has been circumscribed, which is to be detached from the phalanx. Then the bistoury, still held in the first position, is carried to the bottom of the wound, its blade lying flatwise against the phalanx, and by a gently sawing motion, upwards towards the articulation, until an obstacle is encountered which arrests its progress. This is the head of the phalanx ; the blade of the bistoury must be carefully carried around it without allowing it to slip or move irregularly, and as soon as it arrives at the articulation, the diminished resistance will allow it to enter with facility.

3d. The joint is to be cut through with the narrowest portion of the blade of the bistoury, that nearest its point, and in order to effect this part of the operation more readily, the surgeon should make traction upon the fingers, so as to separate the articular surfaces, at the same time that the integuments of the opposite side of the joint are kept out of the way of the edges of the bistoury. The knife having traversed the articulation, it is brought back hugging the opposite side of the

head of the phalanx, and a second semi-circular flap is made like the first, as it cuts its way out through the commissure.

When the double flap amputation is made use of for the index or little fingers, there is but one flap, of course, made from the commissure of the fingers; the other flap, taken from the outer or inner border of the hand, has generally more tendency to contraction, and hence, should be made somewhat larger on this account.

Oval method. Scoutetten's operation.—The surgeon, having grasped the finger as in the preceding description, commences, with the heel of the bistoury held in his right hand, an incision, which, commencing on its dorsal aspect, and a quarter of an inch beyond the articulation, is carried down to the end of the commissure, and thence across the base of the finger on its palmar surface, following exactly in the fold of the skin which lies between the finger and the hand. To facilitate the incision on its palmar surface, the surgeon should carry the finger back into a state of forced extension, but as soon as the knife reaches the commissure on the opposite side, he should flex it again, and resume the same form of incision with which he commenced, carrying it back to join the first near its origin. Each border of the wound should then be detached from the head of the phalanx, and the joint entered from its dorsal aspect, dividing first the extensor tendon, and then the lateral ligaments. By increasing the flexion slightly, and an effort as if to luxate the joint, the division of the flexor tendons is facilitated, and the remaining soft parts being detached, the amputation is finished.

The *circular method* is hardly used at present for the disarticulation of the fingers.

Plate XIX.

DISARTICULATION OF THE FOUR FINGERS; OF THE METACARPAL BONES.

OPERATIONS.

Fig. 1. *Disarticulation of the four fingers at once.* *a*, *b*, *c*, incision over the metacarpo-phalangeal articulations from their dorsal aspect; the knife is about passing beneath the phalanges to cut out a palmar flap.

Fig. 2. Wound resulting from the operation. *a*, *b*, *c*, form of the palmar flap.

Fig. 3. *Disarticulation of the first metacarpal bone*, by a modification of the oval method; *a*, *b*, *c*, outline of the external incision.

Fig. 4. The thumb is carried across the hand, and the knife about completing the disarticulation of the head *a*, of its metacarpal bone.

Fig. 5. Edges of the wound brought together, shewing the appearance of the cicatrix when healed.

Fig. 6. *Disarticulation of the metacarpal bone of the little finger*, by a variety of the oval method; *a*, *b*, *c*, outline and extent of the external incision.

Fig. 7. The preceding operation completed; shape of the cicatrix.

MODES OF OPERATING.

§ 1. *Disarticulation of the four fingers together.—Operation with one flap.—Lisfranc's method* (fig. 1). The hand being pronated, the surgeon grasps the four fingers in the palm of his left hand, whilst his thumb, placed on the dorsal aspect of the fingers, flexes them moderately. An assistant supports the hand, and retracts the skin as much as possible. Then, with a straight narrow knife, the operator makes a curved incision with its convexity looking downwards, from six to eight lines below the heads of the metacarpal bones, from the index towards the little finger if he is operating on the left hand, and in the opposite direction for the right. The extensor tendons being exposed by the retraction of the integuments, which the operator assists by a

Pl. 19.

Fig. 2.

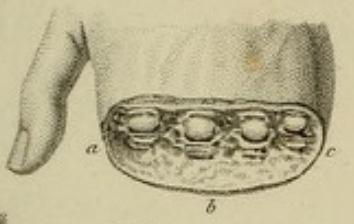


Fig. 7



Fig. 6

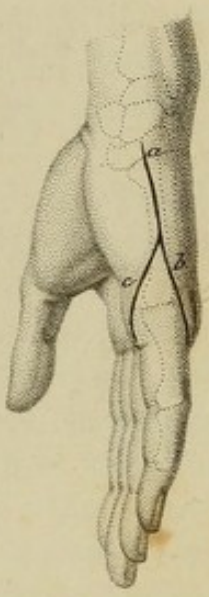


Fig. 1.

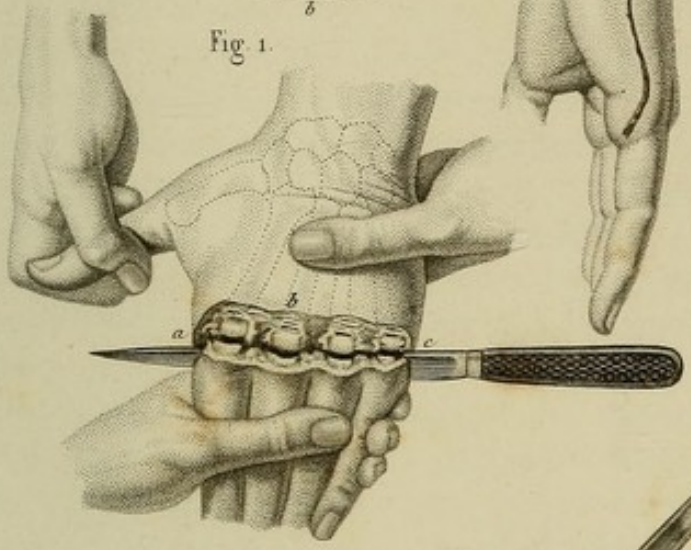


Fig. 3.

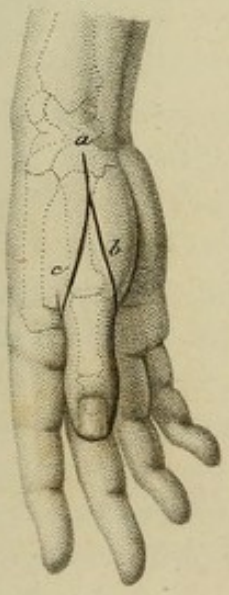


Fig. 4

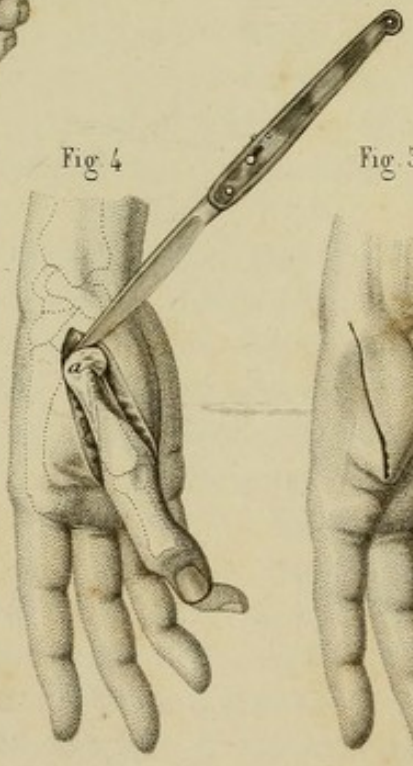
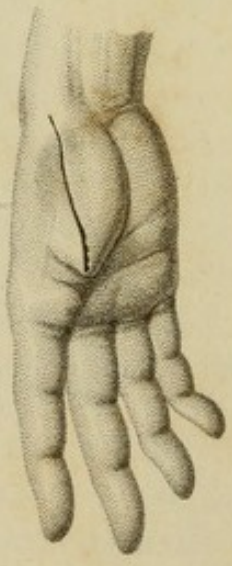


Fig. 5.



few strokes of the knife, each of the metacarpo-phalangeal articulations is then successively opened, the extensor tendon being first divided, then the lateral, and finally the palmar ligamentous attachments. It remains to carry the knife through the articulations to the palmar aspect of the phalanges, and cut out a flap, which is limited anteriorly by the folds in the skin at the base of the fingers on their palmar surface.

§ 2. *Disarticulation of the metacarpal bone of the thumb.—Oval operation.—Scoutetten's method modified by Malgaigne* (fig. 3, 4, 5). The hand being held in a position between supination and pronation, make an incision along the dorsal surface of the metacarpal bone of the thumb, commencing six lines above its articulation with the trapezium, and extending through all the tissues down to the bone, to the inner side of the head of the first phalanx of the thumb, on a level with the commissure between the thumb and index finger. Then, carrying the hand into a state of pronation, continue the incision around the palmar surface of the phalanx to its outside, and thence to the dorsum of the metacarpal bone, to meet the first incision about at its middle (fig. 3). Detach the muscles and integuments from either side of the bone, and open the articulation from its dorsal aspect; then, endeavoring to dislocate the bone outwards, complete the division of its remaining attachments.

§ 3. *Disarticulation of the metacarpal bone of the little finger.—Oval method.—Scoutetten's operation modified by Malgaigne* (fig. 6, 7). The hand being held in a state of forced pronation, commence an incision six lines above the carpo-metacarpal joint, which should be carried down in a straight line to the inner border of the first phalanx of the little finger, until it meets the depression at the base of the finger on its palmar surface, and brought around the base of the finger, following this depression exactly. Then the operator, lifting up the little finger, continues the incision around to its inside, and upwards to join its first portion about opposite to the centre of the metacarpal bone. The integuments and muscles are then detached from the bone, and its articular connections divided with the point of the bistoury in the manner already described.

Plate XX.

AMPUTATION THROUGH THE CARPO-METACARPAL, AND RADIO-CARPAL ARTICULATIONS.

SURGICAL ANATOMY.

Fig. 1. *a*, inferior extremity of the ulna; *b*, that of the radius; *c*, *d*, *e*, *f*, *g*, *h*, *i*, bones of the carpus; 1, 2, 3, 4, 5, first, second, third, fourth and fifth, metacarpal bones.

The *carpo-metacarpal articulation* is represented by an irregular line, the two extremities of which are easily recognised. *Externally*, it corresponds with the upper extremity of the first metacarpal bone; this can be made to start out from its articulation with the trapezium *i*, to which it is connected by rather lax ligamentous attachments, by carrying the thumb across the palm in a state of forced adduction. *Internally*, the carpo-metacarpal joint is marked by the articulation of the fifth metacarpal with the unciform bone, *f*. The long projection at the upper end of the fifth metacarpal serves as a guide to this point, and it can be readily recognised by carrying the finger along the bone from before backwards; the joint lies a line or so above it. The hook-like process of the unciform bone might also be of some assistance as a landmark; the articulation lies immediately below it.

The *radio-carpal articulation* is formed by the inferior extremities of the radius and ulna, which being slightly concave receive the convexity formed by the scaphoid *d*, the semi-lunar *c*, and the cuneiform, *e*. The pisiform bone, situated farther in front and below the line of the articulation, forms a projection on the front of the wrist over which the knife passes necessarily in cutting out the palmar flap. The two styloid processes, that of the radius externally, and of the ulna internally, mark the situation of the joint with accuracy. The styloid process of the radius projects downwards two lines farther than that of the ulna; and the articulation lies about two lines and a half above a line passing through the extremities of the two processes. The second fold in the skin on the palmar surface of the wrist, reckoning from the palm, lies immediately over the articulation, and would also answer as a guide to it in case the position of the styloid processes could not be distinguished.

Fig. 1.

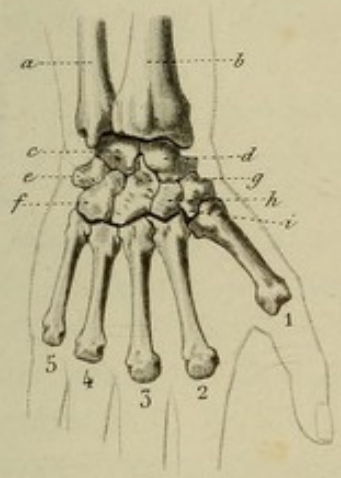


Fig. 3.



Fig. 2.

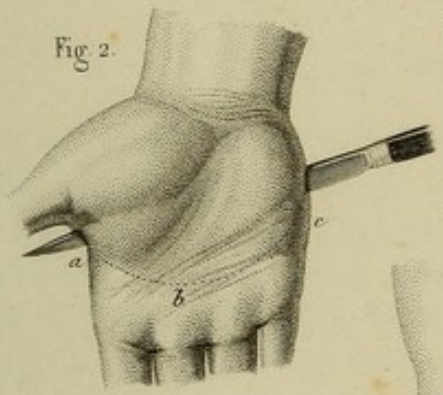


Fig. 6.



Fig. 4

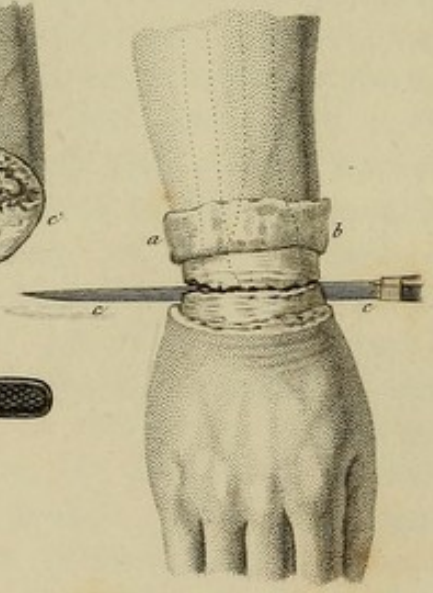


Fig. 5.

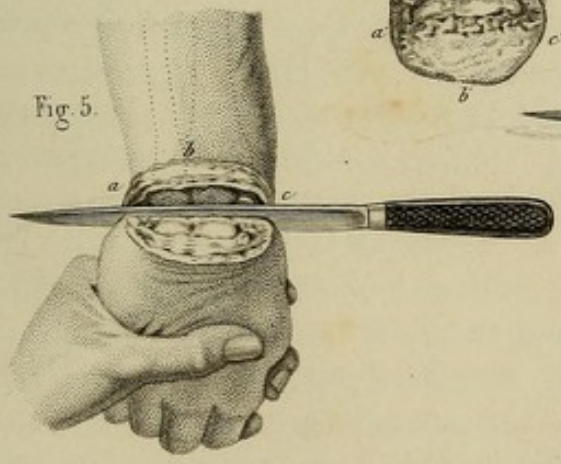


Fig. 2. *Disarticulation of all the metacarpal bones, preserving that of the thumb. Maingault's operation.* *a*, *b*, *c*, form of the palmar flap.

Fig. 3. Same operation. *a*, *b*, *c*, incision in the integuments on the back of the hand ; the joint is about being opened.

Fig. 4. *Amputation through the wrist-joint.* Circular operation. *a*, *b*, fold of integuments turned up like the cuff of a sleeve; *c c*, knife dividing circularly the tendinous tissues around the joint.

Fig. 5. *Denonvilliers' method.* Flap operation. *a*, *b*, *c*, semi-circular incision on the back of the wrist. The knife is cutting out the palmar flap.

Fig. 6. Stump, showing shape of wound. *a*, *b*, *c*, palmar flap.

MODES OF OPERATING.

§ 1. *Disarticulation of the four metacarpal bones of the fingers. Operation with a single flap. Maingault's method.* (fig. 2 and 3.) 1st. The hand being held in the position of forced supination, recognise at its outer border the articulation of the first metacarpal bone with the trapezium, and, at its internal side, the articulation of the unciform bone with the fifth metacarpal. 2nd. Introduce a small, straight knife between the bones and the soft parts, carrying it a little below the projections formed by the unciform and the trapezium, so as to bring out its point below the thumb. 3d. Carry the blade of the knife along the anterior surfaces of the metacarpal bones, and cut out a large flap of an elliptical outline. 4th. Then turn the hand in the prone position, and make a semi-circular incision across its back, two thirds of an inch below the line of the articulations, and carrying the knife through the tissues connecting the thumb with the index finger, join the first incision. Whilst an assistant is drawing the integuments upwards, the surgeon, holding the metacarpus in his left hand, proceeds with the disarticulation from the front of the hand, commencing with the metacarpal bone of the index or the little finger, according as he is operating upon the right or left hand.

§ 2. *Amputation through the wrist-joint. 1st. Circular operation. Ordinary method.* (fig. 4.) 1st. One assistant forcibly retracts the skin of the forearm, whilst a second holds the hand to be removed. 2d. The surgeon, holding the knife in his right hand, makes

a circular incision through the integuments, just grazing the thenar and hypothenar eminences at the root of the palm. 3d. He then dissects up the skin as far as the line of the articulation, and reflects it upwards, like the cuff of a coat sleeve. 4th. Second circular incision is then carried through the tendons, and the joint is cut through from its dorsal towards its palmar aspect.

2d. *Operation with a single flap. Denonvilliers' method.*—The hand being held conveniently in a state of pronation, and the integument strongly retracted by an assistant, the operator satisfies himself of the position of the styloid processes of the radius and ulna, grasps them with the thumb and index finger of his left hand, and makes a semi-circular incision with its concavity looking downwards across the back of the wrist, its two extremities falling a little below the styloid projections of the two bones. After this first incision through the skin and cellular tissue, the retraction of the integuments upwards and downwards leaves the wrist joint entirely exposed. A second incision then, in the same direction as the first, across the articulation, divides the extensor tendons and the posterior radio-carpal ligaments. The lateral ligaments are now cut through, and the knife carried through the joint in front of the carpal bones in order to cut out an anterior or palmar flap, which should be at least two-thirds of an inch in length. In order to complete this flap without difficulty, the edge of the knife should be turned sufficiently away from the bones of the carpus so as not to be arrested by their projections, and especial care should be taken that the pisiform bone is not cut away with the flap. After disarticulation by the process just described, there is no danger of the protrusion of the styloid apophyses through the angles of the wound; if the tendons are too long, they may be cut shorter before the wound is dressed.

Pl. 21.

Fig. 3.

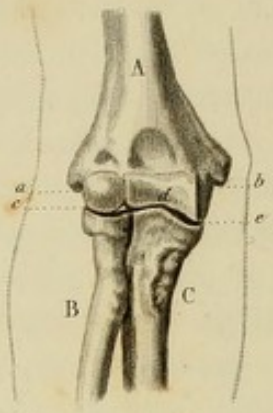


Fig. 1.

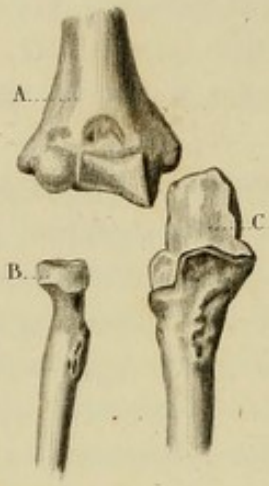


Fig. 2.

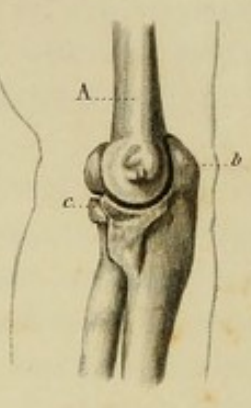


Fig. 4.

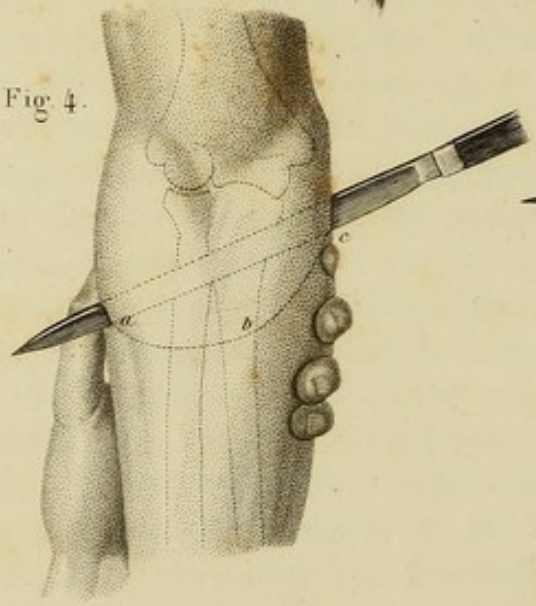


Fig. 5.

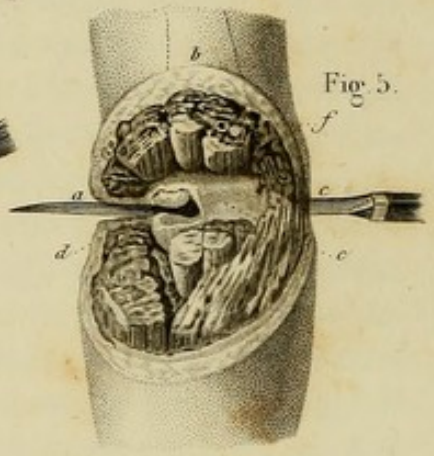


Fig. 6.

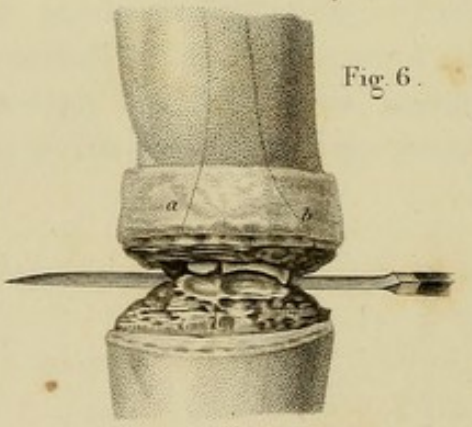


Fig. 7.

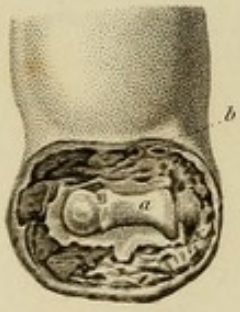


Plate XXI.

AMPUTATION AT THE ELBOW-JOINT.

SURGICAL ANATOMY.

Fig. 1. The elbow joint is composed of the inferior extremity of the humerus, A, and the superior extremities of the radius, B, on the outside, and the ulna, C, on the inside.

Fig. 2. The radius is merely in juxtaposition with the humerus, whilst the ulna receives its trochlea in a corresponding depression of considerable depth, formed by the olecranon, *b*, behind, and the coronoid process, *c*, in front; this arrangement prevents the articulation from being opened directly, except from its outer side. The articular surfaces are retained in contact by anterior, posterior, and lateral ligaments.

Fig. 3. To recognize the exact position of the articulation, its relation to the neighboring bony projections is to be determined; the internal condyle, or epitrochlea, *b*, is prominent and easily detected; the external condyle, or epicondyle, *a*, is less prominent, and blends insensibly with the external aspect of the humerus. The two condyles, situated almost exactly on a horizontal line to which the axis of the humerus is perpendicular, lie just above the inter-articular line, *c*, *d*, *e*, whose two extremities are unequally distant from the horizontal line *a*, *b*. In fact, its external end, *c*, is but three and a half lines below the most inferior point of the external condyle, *a*, whilst its internal extremity is at least double that distance below the most inferior point of the internal condyle, *b*, (*Malgaigne.*)

OPERATIONS.

Fig. 4. *Flap operation.*—*a*, *b*, *c*, form of the anterior flap.

Fig. 5. *a*, *b*, *c*, anterior flap turned upwards; *d*, elbow joints opened; *e*, knife about to complete the division of the anterior ligament of the joint.

Fig. 6. *Circular operation. Velpeau's method.*—*a*, *b*, fold of integuments reflected.

Fig. 7. Wound which is left after the circular operation; *a*, lower end of the humerus; *b*, section of the humeral artery.

MODES OF OPERATING.

§ 1. *Method with a single flap.*—(Fig. 4 and 5.)—The forearm should be supinated as completely as possible, and held in a slightly flexed position. The surgeon, then, standing on the inner side of the limb, grasps the soft parts lying immediately in front of the articulation, and raises them from the bones of the forearm. He passes in a straight knife, from the inner side of the joint, about an inch below the prominence of the internal condyle, and keeping its point well in contact with the bones of the forearm, bring it out half an inch below the prominence of the external condyle, and cuts out a semi-circular anterior flap three inches in length. This flap being at once carried backwards by an assistant, who also retracts the skin of the arm so as to draw the angles of the wound as far upwards as possible, the surgeon carries his knife to the outside of the limb at the base of the flap, and at once enters its heel between the articulation of the radius with the humerus; he then continues his transverse incision across the back part of the forearm through all the tissues, until he reaches the inner angle of the wound. Nothing remains then but to divide the anterior and lateral ligaments of the joint with the point of the knife, and, by luxating the bones forward, to cut through the insertion of the *triceps*, which is still attached to the olecranon process.*

§ 2. *Circular operation. Velpeau's method.*—(Fig. 6 and 7.)—The arm being held in the same position as in the preceding operation, but the surgeon standing on the outside of the limb, a circular incision is made around the forearm three fingers' breadth below the elbow joint; the integuments are dissected up as far as the joint, and reflected upwards, and then the muscles in front of the joint are cut through, with the lateral ligaments, the joint entered in front, and the operation terminated by the division of the triceps behind.

In this mode of operating, the brachial artery is divided above its bifurcation, and the form of the wound is supposed to favor its union by the first intention.

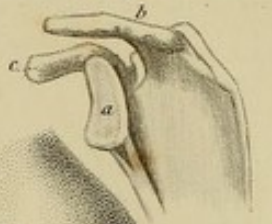
* Some surgeons prefer to saw across the olecranon, and thus to leave the insertion of the triceps muscle untouched. The result is not materially different.—Eds.

Pl. 22.

Fig. 1.



Fig. 2.



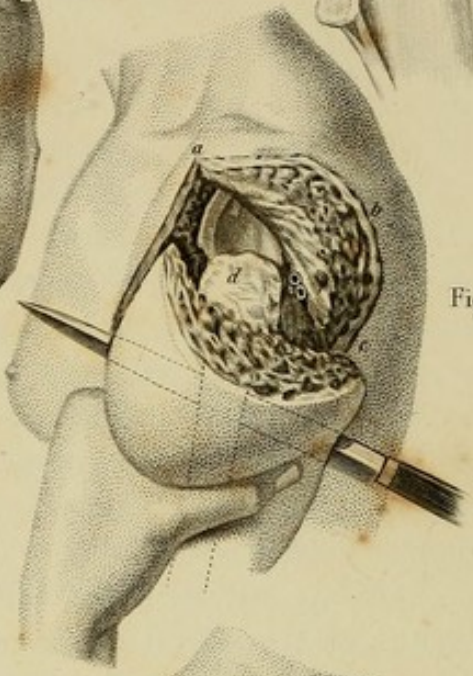


Fig. 4.

Fig. 3.

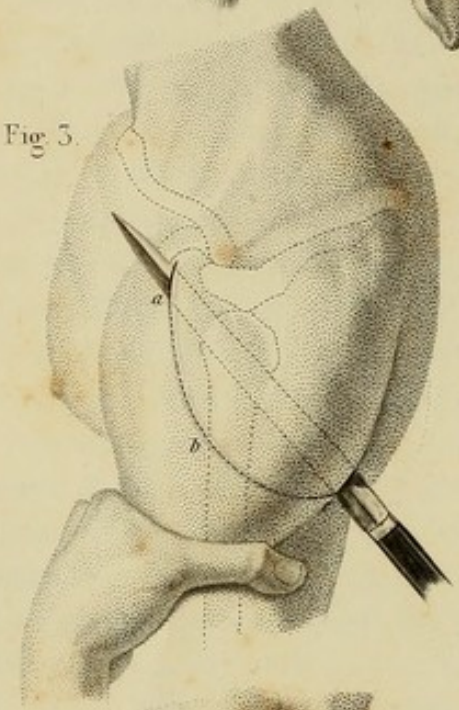


Fig. 5.

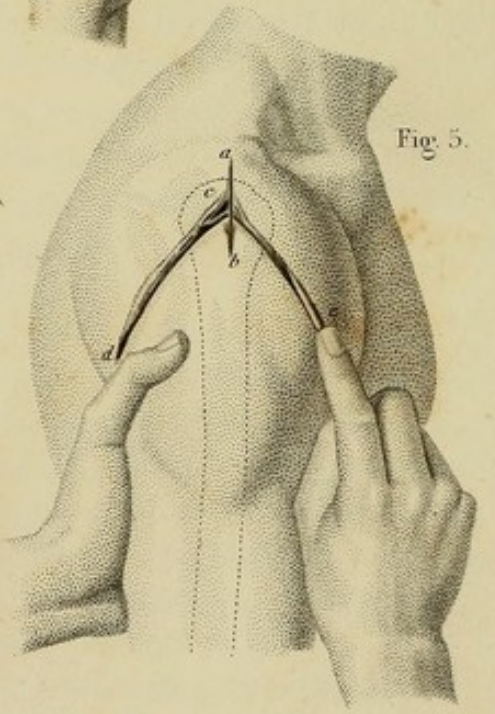


Fig. 6.

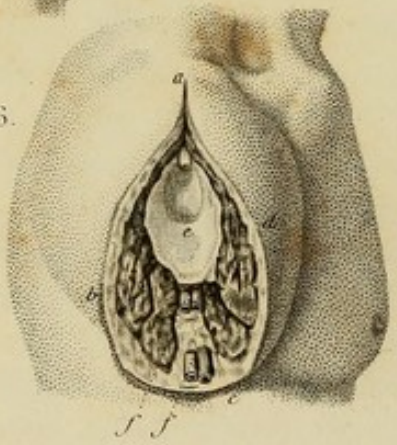


Plate XXII.

AMPUTATION AT THE SHOULDER JOINT.

SURGICAL ANATOMY.

Fig. 1. *a*, head of the humerus; its shape is that of an almost perfect hemisphere; *b*, clavicle; *c*, acromion; *d*, infra-spinous fossa of the scapula; *e*, head of the humerus, connected with the glenoid cavity by the capsular ligament of the joint.

Fig. 2. *a*, glenoid cavity; it presents an elongated concave articular surface which receives but about one-third of the articular surface of the head of the humerus; *b*, acromion; *c*, coracoid process.

The head of the humerus is connected with the glenoid cavity by a loose capsular ligament, which would allow a considerable amount of separation between the articular surfaces, if they were not also retained in contact by the muscles arising from the scapula. The *supra-spinatus*, the *infra-spinatus*, the *teres major* and *minor* behind, and the *subscapularis* in front contribute to strengthen the joint, as well as the ligamentous fibres extending from the acromion to the capsule of the joint, and the deltoid muscle.

The acromion and coracoid processes form an arch which protects the articulation above. The acromion is situated nearly half an inch above the glenoid cavity, and projects an inch beyond it. The coracoid process situated within and lower down, is more nearly in contact with the head of the humerus.

OPERATIONS.

Fig. 3. *Lisfranc's operation.*—*a*, *b*, *c*, shape to be given to the posterior flap.

Fig. 4. *a*, *b*, *c*, posterior flap raised upwards; *d*, head of the humerus disarticulated.

Fig. 5. *Larrey's operation.*—*ab*, first incision, vertical; *cd*, posterior incision taking its origin from the first; *ce*, anterior incision starting also from the same point.

FIG. 6. *a*, *b*, *c*, *d*, wound which is left after the preceding operation; *e*, glenoid cavity and remains of the capsular ligament; *ff*, axillary vessels.

MODES OF OPERATING.

§ 1. *Disarticulation of the shoulder.—Operation with two flaps.—Lisfranc's method* (fig. 3, 4).

1st. The patient is supported in a convenient position upon a chair, and the arm kept close to the trunk, the head of the humerus at the same time being pushed upwards and outwards as much as possible. The surgeon then, being provided with a long straight knife cutting on both edges, assures himself of the exact position of the acromion and coracoid processes. If it is the left shoulder upon which he is about to operate, the point of the knife should be entered in a direction almost parallel with the humerus at the outer side of the posterior border of the axilla, in front of the tendons of the *latissimus dorsi* and *teres major* muscles. As the knife passes in, the plane of its blade should form an angle of 35° with the axis of the shoulder, and its point should graze the posterior and external surface of the humerus, until it reaches the under surface of the acromion; at this point the handle of the knife should be raised, and its point lowered, so that it is brought out below and in front of the clavicle, in the triangular space between the acromion and coracoid processes, which is bounded posteriorly by the clavicle. The knife should then be made to cut its way outwards around the head of the humerus, and as soon as it becomes disengaged from beneath the acromion, the arm is carried a little distance away from the trunk, and the surgeon grasps with his left hand the deltoid muscle, raising it as much as possible from the bone, and carries the knife directly downwards, grazing the bone, and cutting out a posterior semicircular flap about three inches in length. In making this flap the upper part of the capsule of the joint should be divided, as well as the tendons of *latissimus dorsi*, the *teres major and minor*, and a part of the deltoid.

2d. The head of the humerus being readily separated from the glenoid cavity after the division of the parts just mentioned, the operator passes the blade of the knife behind it, and carries it downwards and forwards, grazing the humerus, to cut out the internal flap, and at this moment the artery contained in the substance of this flap should be compressed by an assistant. In operating upon the shoulder of the

right side the same rules are followed, except that the knife should be entered in the infra-clavicular triangle described above, to be brought out at the posterior border of the axilla, thus reversing the direction of the knife in transfixing the articulation to cut out the posterior flap.

§ 2. *Oval operation.—Larrey's method* (fig. 5, 6).—Make a vertical incision on the outer surface of the shoulder through the skin and subjacent tissues down to the bone, and extending from the edge of the acromion process to a point one inch below the top of the humerus; 2d, make then two oblique incisions starting from the centre of the vertical one, one on the anterior, and the other on the posterior aspect of the joint, carrying them through the tissues composing the anterior and posterior walls of the axilla, to the lower border of each, and dividing their attachments to the humerus; 3d, push the edges of the wound on either side to expose the joint, and open it, making traction on the bone to put its ligament on the stretch; 4th, luxate the bone, pass the knife behind it, and finish the operation by cutting directly through the tissues in the axilla, which intervene between the extremities of the incisions already made, recollecting that the artery is contained in them, and requires to be compressed by an assistant. The wound which results from this operation is almost perfectly oval in shape (fig. 6).

Plate XXIII.

DISARTICULATION OF THE TOES.

SURGICAL ANATOMY.

Fig. 1. *Bones of the foot.—Dorsal aspect.—a* and *b*, inferior extremities of the tibia and fibula; *c*, astragalus; *d*, os calcis; *e*, scaphoid; *f*, cuboid; *g*, internal cuneiform; *h*, middle cuneiform; *i*, external cuneiform; 1, 2, 3, 4 and 5, first, second, third, fourth and fifth metatarsal bones; *k*, *k*, *k*, *k*, *k*, phalanges of the toes.

Fig. 2. *Articular ligaments of the dorsum of the foot.—a*, *a*, anterior tibio-tarsal ligaments; *b*, anterior fasciculus of the internal lateral ligament; *c*, internal calcaneo-scaphoid ligament; *d*, external calcaneo-astragaloid ligament; *e*, superior astragalo-scaphoid ligament; *f*, the superior calcaneo-cuboid ligament; *g*, *g*, *g*, scaphoido-cuneiform ligaments; *h*, cuboido-metatarsal ligament; *i*, *i*, *i*, cuneo-metatarsal ligaments; *k*, *k*, *k*, *k*, *k*, articulations of the metatarsal bones between themselves, and of the phalanges with the metatarsal bones; *l*, *l*, *l*, *l*, *l*, lateral ligaments of the phalanges.

Fig. 3. *Horizontal section of the bones of the tarsus*, showing the inter-articular ligaments.

OPERATIONS.

Fig. 4. *Disarticulation of the third, and of the great toe.—a*, *b*, *c*, *d*, wound resulting from the oval operation; *e*, head of the first metatarsal bone; *f*, *g*, *h*, wound resulting from the flap operation; *i*, head of the third metatarsal bone.

Fig. 5. *Disarticulation of the five toes together.—a*, *b*, *c*, form and direction of the incision across the heads of the metatarsal bones.

Fig. 6. The integuments *a*, *b*, *c*, are retracted, and the knife is carried behind the heads of the phalanges in order to make a flap from the plantar surface of the foot.

Fig. 7. Wound which results from the preceding operation.—*a*, *b*, *c*, shape of the plantar flap.

Pl. 23.

Fig. 1.



Fig. 3.



Fig. 2.



Fig. 4.

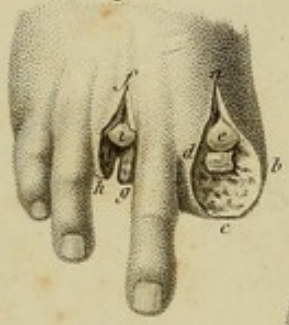
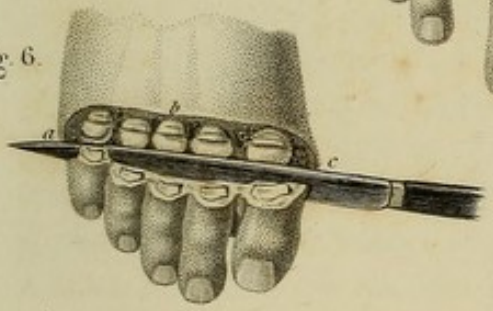


Fig. 6.



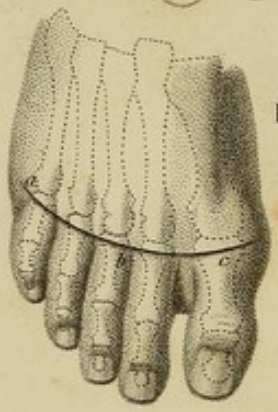


Fig. 5.

Fig. 9.

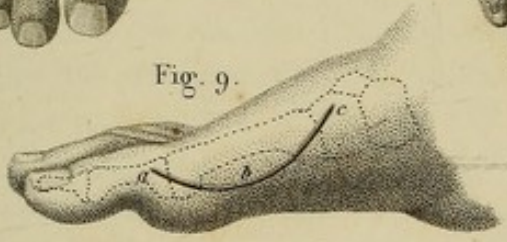


Fig. 7.

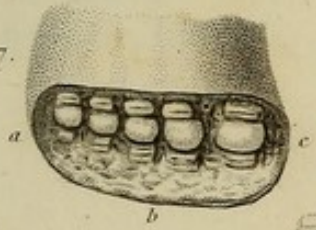




Fig. 8.

Fig. 8. *Disarticulation of the first metatarsal bone.—a, b, c, d,* outline of the incision.

Fig. 9. *a, b, c,* incision employed in disarticulation of the first metatarsal bone, without removing the great toe, (see " exsections.")

MODES OF OPERATING.

§ 1. *Disarticulation of a single toe* (fig. 4.)—The rules laid down for the disarticulation of the fingers are entirely applicable to the corresponding operations upon the toes; we will only remark, that the oval operation is most generally preferable, as it is very rare that less than an entire toe is removed; the small size of the phalanges, and their unimportance, renders the preservation of a single phalanx a matter of much less moment than in the hand.

It has been proposed by many surgeons, that in disarticulation of the great toe, (fig. 8,) the head of its metatarsal bone should be removed at the same time, on account of the unsightly projection, which, moreover, is a source of constant irritation from the friction of the shoe in walking. (See " exsection " for further remarks on this subject, and for amputation of the metatarsal bones.)

§ 2. *Disarticulation of all the toes at the same time. Flap operation. Lisfranc's method* (fig. 6 and 7,)—1st. The operator, grasping all the toes in his left hand, makes, with a narrow knife, a semi-circular incision, extending (for the left foot, and *vice versâ*) from the internal border of the first metatarsal bone, to the external border of the fifth, in front of the articulations of the toes with the metatarsus, (fig. 5); 2d, the articulations are opened in succession with the point of the knife, and their ligaments divided; 3d, the knife is then carried behind the phalanges for the purpose of cutting out a semi-circular flap from the plantar surface of the foot, (see fig. 6.)

Plate XXIV.

AMPUTATION THROUGH THE TARSO-METATARSAL ARTICULATION.

SURGICAL ANATOMY.

Fig. 1. The tarso-metatarsal articulation, formed posteriorly by the cuboid, *a*, and the three cuneiform bones, *b*, *c*, *d*, and in front of the five metatarsal bones, presents an irregularly curved line, the general direction of which, with its irregularities, require attention. Externally, the cuboid, *a*, articulates with the fourth and fifth metatarsal bones, making a line somewhat oblique from without inwards, and from behind forwards. This line presents a very obtuse angle about its middle, the articulation of the fourth being less oblique than that of the fifth metatarsal bone. About the twelfth of an inch farther forwards is the articulation of the third metatarsal with the internal cuneiform, *b*; at least two lines behind this articulation lies that of the second metatarsal with the middle cuneiform, *c*; and, finally, nearly the third of an inch in front of the last we find the line of articulation of the first metatarsal with the internal cuneiform, *d*.

This arrangement presents two especial points for the consideration of the operator: 1st, the internal extremity of the articulation lies at least seven lines anterior to a transverse line *e*, *f*, drawn directly through its external extremity; 2d, the proximal extremity of the second metatarsal bone is enclosed in a mortise formed by the three cuneiform bones, *b*, *c*, *d*, which is at least one-third of an inch deep antero-posteriorly.

The dorsal ligaments connecting the tarsal and metatarsal bones are inserted several lines behind and in front of the inter-articular line, and hence the articular surfaces can always be partially separated, even when these are cut across not exactly upon the inter-articular line. The interosseous ligaments, which are stronger towards the plantar aspect of the foot, are generally easily divided; nevertheless, those situated on the inner side of the mortise, which connect the second metatarsal with the first and second cuneiform bones, the real key to the articula-

Fig. 1.bis

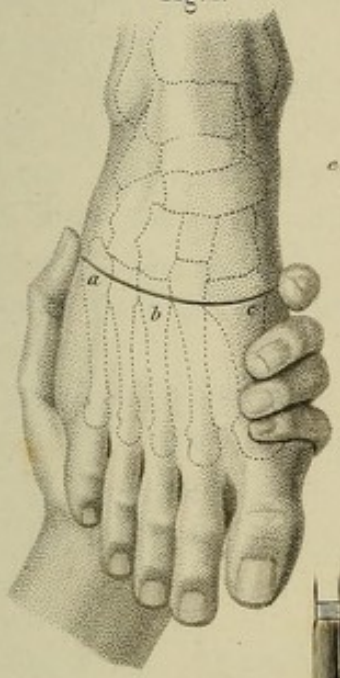


Fig. 1.



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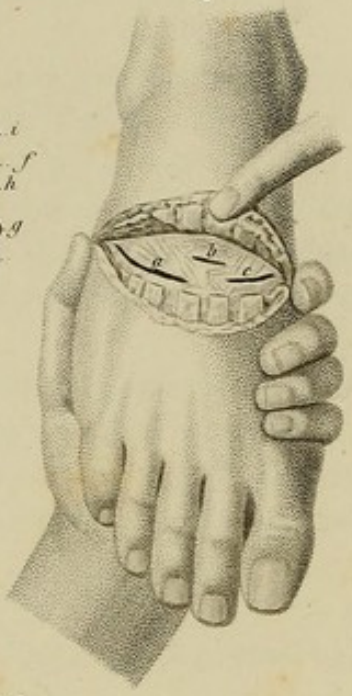


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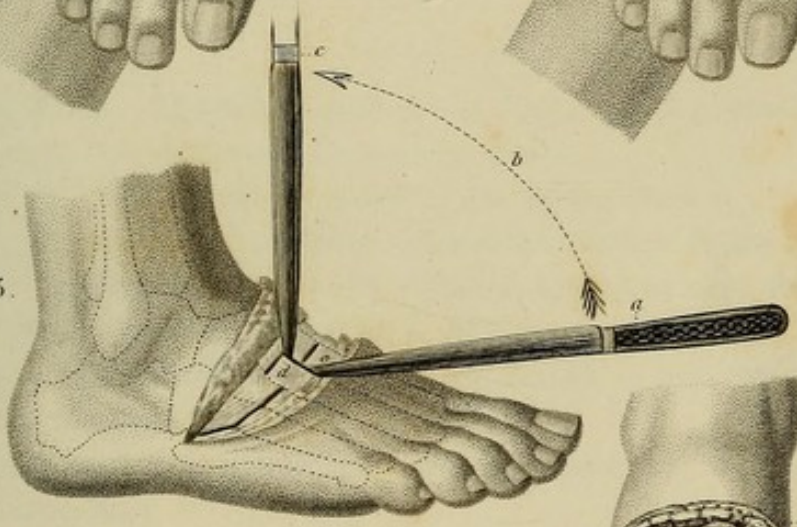


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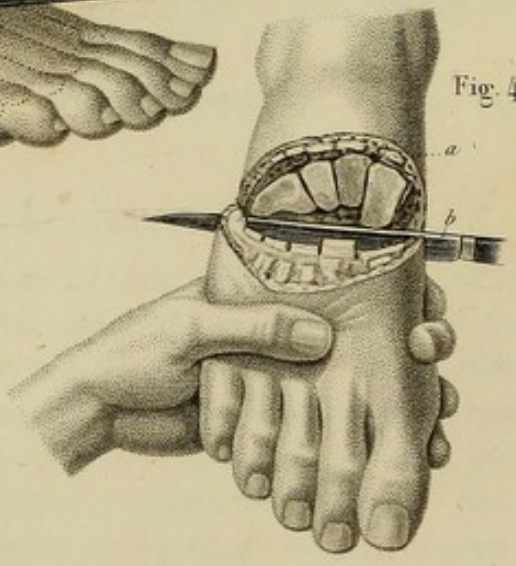
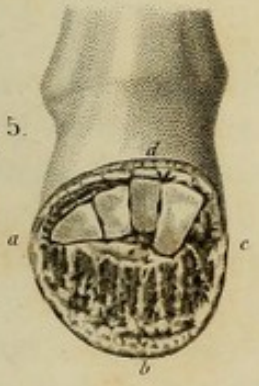


Fig. 5.



tion, require for their ready division a particular manœuvre to be hereafter described.

To recognize the articulation.—1st. On the inner side of the foot, carry the finger backwards along the inner border of the first metatarsal bone until a projection is encountered, *g*; one or two lines beyond this is the articulation, situated in a depression between the two projections marked *g* and *h*, the internal cuneiform. The articulation may also be found just one inch anterior to the prominence of the scaphoid bone, *i*.

2d. On the outer side: Follow the external border of the fifth metatarsal bone until the prominence at its proximal extremity is recognized, *k*; the articulation lies immediately behind it; in some instances, the head of the metatarsal bone projects a trifle beyond the articulation.

OPERATIONS.

Fig. 1 *bis*. *Lisfranc's method.*—*a*, *b*, *c*, form and direction of the incision to be made across the metatarsus.

Fig. 2. *a*, *b*, *c*, dorsal ligaments of the tarsus, divided.

Fig. 3. *Manner of opening the mortise formed by the head of the second metatarsal bone.*—*a*, *b*, *c*, are of the circle to be described by the knife; *d*, second metatarsal; *e*, first metatarsal bone.

Fig. 4. *a*, *dorsalis pedis* artery. The knife, *b*, is in the act of cutting out the plantar flap.

Fig. 5. *a*, *b*, *c*, *d*, wound left after the operation; *a*, *b*, *c*, shape of the plantar flap.

MODES OF OPERATING.

1st. The patient is placed upon his back, and the foot rotated moderately inwards. The surgeon recognizes the exact situation of the articulation by the rules already laid down, and then grasps, with the palm of his left hand, the sole of the foot, his thumb being placed on the outer side of the proximal end of the fifth metatarsal bone, and the index finger at the internal extremity of the articulation. He then makes a semi-lunar incision with its convexity looking downwards, from without inwards, across the dorsum of the foot, passing about half an inch below the articulation, and extending from one of its extremities to the other down to the bones.

2d. The surgeon divides, with the point of his knife, the dorsal ligaments, carrying it along the line of the articulation from without in-

wards, as already indicated, and recollecting that the articulation of the second metatarsal lies a third of an inch posterior to the others, (fig. 2.)

3d. The mortise in which the head of the second metatarsal is enclosed remains to be opened. This is effected by introducing the point of the knife between the internal cuneiform and the head of the first metatarsal bone, its edge being turned upwards, and making an angle of 45° with the axis of the foot. The knife is then carried up to a right angle, its point traversing the whole of the inner surface of the mortise, in order to insure the division of the interosseous ligament; it is then withdrawn, and applied to the external surface of the mortise.

4th. When this has been accomplished, pressure is made upon the metatarsus to separate the articular surfaces, and their remaining ligamentous attachments are successively divided, especially those on the plantar aspect of the articulation, so that the knife may be carried readily beneath the heads of the metatarsal bones, and the operation is then finished by cutting out a flap from the sole of the foot, which should be somewhat larger at its internal than at its external part.*

* The operation above described is generally known in this country as *Lisfranc's operation* on the foot, and it is distinguished by this title from *Hey's operation* through the metatarsus, in which the bones are divided with the saw, and *Chopart's operation* through the tarsus, as next described.—Eds.

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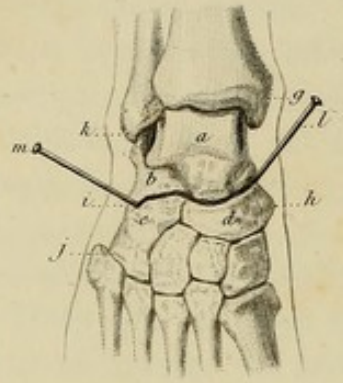


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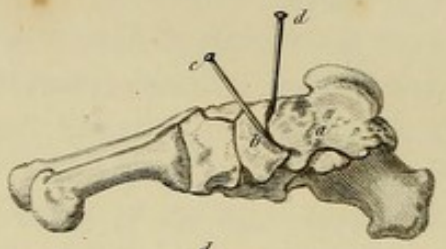


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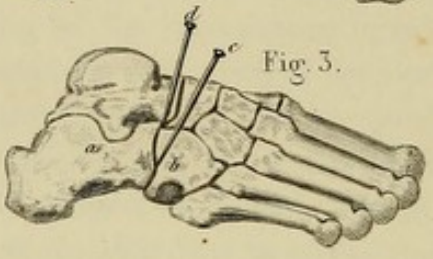


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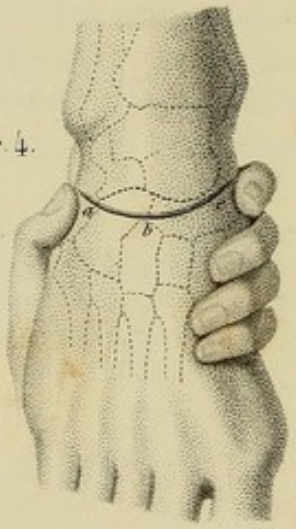


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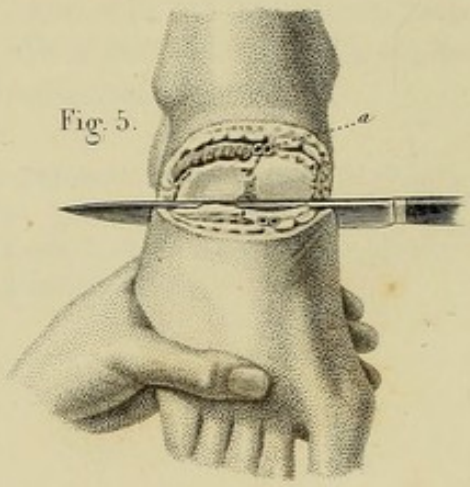


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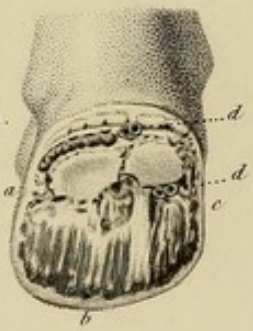
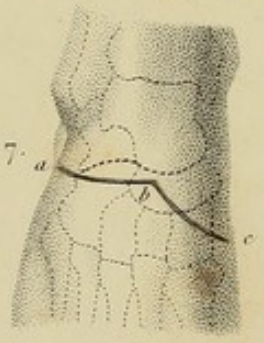


Fig. 7.



AMPUTATION THROUGH THE TARSUS, OR CHOPART'S OPERATION.

SURGICAL ANATOMY.

FIG. 1. The articulation at the middle of the tarsus is formed by the astragalus, *a*, and the os calcis, *b*, behind, and by the cuboid, *c*, and scaphoid, *d*, in front, and the inter-articular line, which crosses the foot transversly, resembles the i : lic ∞, of which the anterior convexity is internal, and its posterior convexity, external.

The internal extremity of the articulation is just one inch in front of the internal malleolus, *g*, and two lines and a half behind the tuberosity, *h*, of the scaphoid.

The external extremity, *i*, is half an inch behind the projection formed by the head of the fifth metatarsal bone, *j*. It corresponds with a prominence on the external surface of the cuboid bone, which is situated just one inch in front of the external malleolus, *k*.

The centre of the articulation lies immediately in front of the head of the astragalus, which can be made to project by forcibly extending the foot. On the outside of this prominence is a depression, sensible to the touch, lying between the astragalus, the cuboid, and the os calcis; the articulation is immediately in front of this (*Malgaigne*).

In order to cut through the joint readily, it is necessary to be familiar with the different directions which are assumed by its articular surfaces. The pin, *l*, introduced between the astragalus and scap' oid, indicates the direction to be given to the knife in opening the articulation from its internal side.

The pin, *m*, introduced between the os calcis and cuboid, just in front of the prominence on the cuboid mentioned above, indicates also the direction to be given to the knife in entering the joint from its external side.

FIG. 2. When it has once entered the articulation by its inner side, the blade of the knife should follow the different degrees of obliquity assumed by the articular surfaces, of the astragalus, *a*, and the os calcis, *b*; at first directed obliquely backwards as at *c*, it becomes almost perpendicular at *d*.

Fig. 3. In operating upon the right foot, the blade, slightly oblique at *c*, will become more nearly perpendicular at *d*, between the os calcis, *a*, and the cuboid, *b*, when the joint is entered from its external side.

The interosseous ligament which is found about in the centre of the articulation, and which connects the four bones together, should always be cut through with the point of the knife as soon as the bones can be sufficiently separated. In aged subjects it is sometimes ossified; in this case it must be divided with the saw. The other ligaments require no particular remark.

OPERATIONS.

Fig. 4. *Ordinary method.*—*a*, *b*, *c*, form and direction of the incision to be made across the joint.

Fig. 5. The joint being cut through, the knife is about making the flap from the sole; *a*, *dorsalis pedis* artery.

Fig. 6. *a*, *b*, *c*, form of the plantar flap; *d* and *d'*, the dorsal and plantar arteries.

Fig. 7. *Sedillot's method.*—*a*, *b*, *c*, form of the incision on the dorsum of the foot.

MODES OF OPERATING.

§ 1. *Chopart's operation through the middle of the tarsus* (fig. 4 and 5).—*Ordinary method.*—1st, the exact position of the articulation having been recognized by the means already indicated, the surgeon grasps the foot with his left hand, its sole being placed in his palm, his thumb upon the external extremity of the articulation, and the index finger upon the tuberosity of the scaphoid bone; 2d, the knife is then to be carried across the dorsum of the foot, from the thumb towards the index finger (fig. 4), making a semi-circular incision which descends about half an inch below the line of the articulation; 3d, after the retraction of the integuments, divide the tendons which remain uncut, and open the articulation, bearing in mind the varying obliquity of the articular surfaces as already indicated, and also to divide thoroughly the fibrous bands connecting the scaphoid and astragalus before attempting to enter the joint, as the thin edge of the scaphoid juts over the latter in some degree; 4th, the articulation being entirely laid open, and all its ligaments freely divided, pass the flat of the blade behind the bones, and having brought up the end of the foot into its natural position, cut out a flap from its plantar surface, which should extend be-

yond the sesamoid bones in order to possess sufficient length; the knife should graze the bones in making the flap, care being taken to avoid the projections of the scaphoid, cuboid and first and fifth metatarsals.

§ 2. *Sedillot's method* (fig. 6 and 7).—After determining the position of the articulation, and the foot being properly supported, a transverse incision is made, commencing a few lines in advance of the calcaneo-cuboid articulation, and terminating about the middle of the dorsum of the foot, on the outer side of the tendon of the *tibialis anticus*. From this same point a curved incision, with its convexity downwards, is then carried around the inner border of the foot, extending downwards to within two fingers' breadths of the metatarso-phalangeal articulation of the great toe, and thence across the sole to the commencement of the first incision. The plantar integuments should be cut as much as possible in a slanting direction to rid their edges of the subcutaneous fat, the protrusion of which tends to prevent the union by the first intention. It remains now to dissect up the internal flap to just beyond the tuberosity of the scaphoid bone, where the joint is to be entered. The disarticulation is then completed as usual, and the remaining soft parts divided transversely.*

* *Amputation through the ankle-joint*, although not an operation in general use at the present day, is highly praised by Baudens, amongst the French surgeons, and also by Mr. Syme of Edinburgh, who has lately reintroduced it with much success. Each of these surgeons has a mode of operating peculiar to himself. (See Malgaigue, Eng. ed., p. 255, and Lond. and Ed. Monthly Journal, Feb., 1843, p. 93.)—Eds.

Plate XXVI.

AMPUTATION AT THE KNEE-JOINT.

SURGICAL ANATOMY.

Fig. 1.—*Anterior view of the knee-joint.*—*a*, femur; *b*, patella; *c*, tibia; *e*, fibula; *g*, external lateral ligament; *f*, internal lateral ligament; *d*, ligament of the patella.

Fig. 2. *A vertical antero-posterior section exhibiting the crucial ligaments*, *d*, and the popliteal artery, *e*. *a*, femur; *b*, tibia; *c*, patella.

This articulation possesses some anatomical peculiarities worthy of the attention of the operator. The internal condyle descends lower than the external, nearly half an inch. They are both received into concave articular surfaces on the head of the tibia, which are rendered deeper by the semi-lunar cartilages attached to their edges. The popliteal artery, (fig. 2, *e*) lies in the depression between the two condyles, posteriorly, and in immediate contact with the joint.

In addition to the patella and its tendinous connections, the articular surfaces are held together by an internal and external lateral ligament, a posterior ligament, and two very strong interosseous ligaments, called crucial, which also tend to prevent displacement in an antero-posterior direction.

To determine the exact position of the joint, find out the head of the fibula, and three-fourths of an inch above it is the inner side of the articulation. On the external aspect of each of the condyles of the femur is a prominence of bone which can generally be felt beneath the integuments; the articulation lies three-fourths of an inch below these. The lower border of the patella, also, is exactly on a line with the joint.

Pl. 26.

Fig. 3.

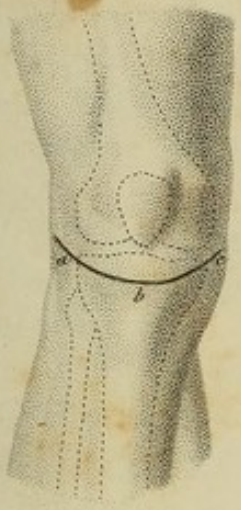


Fig. 1.

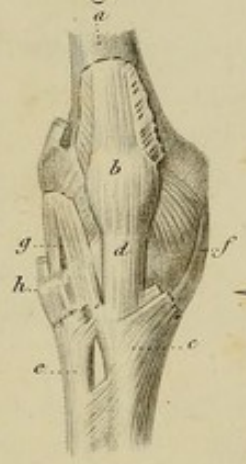


Fig. 5.

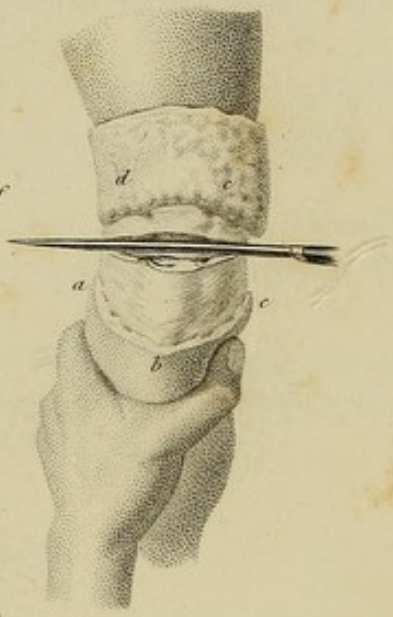


Fig. 2.

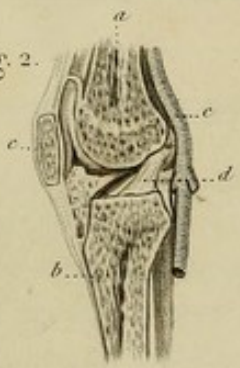


Fig. 4.

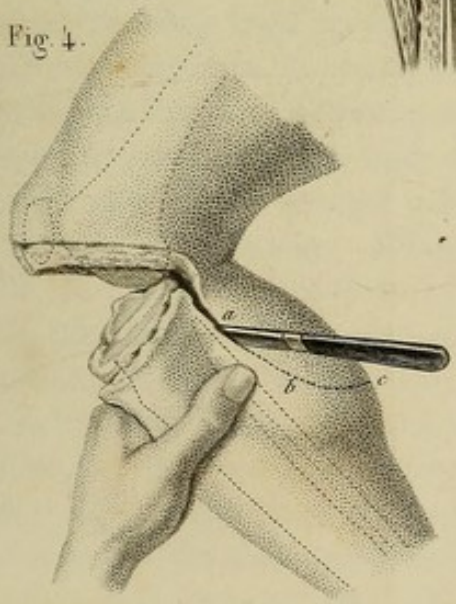


Fig. 6.

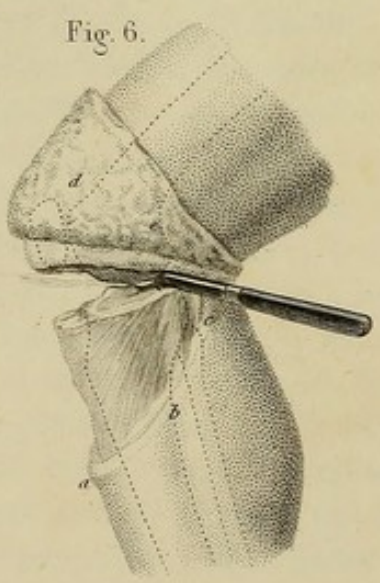


FIG. 3. *Amputation through the knee-joint.—Flap operation.—a, b, c,* form to be given to the anterior incision.

FIG. 4. Same operation.—The articulation having been opened, the knife is cutting out the posterior flap; *a, b, c,* shape to be given to this flap.

FIG. 5. *Same operation by the circular method.—a, b, c,* section of the skin; *d, e,* integuments reflected; the knife is just entering the joint in front.

FIG. 6. *Same operation by the oval method.—Bauden's process. a, b, c,* oblique section of the skin; *d, e,* integuments turned upwards; the knife is opening the articulation from before backwards.

MODES OF OPERATING.

§ 1. *Amputation through the knee-joint.*—1st. *Flap operation.—Hoin's method.*—1st, the limb being extended make a semi-circular incision across the front of the articulation immediately below the patella, and extending from one condyle of the femur to the other; 2d, by a second incision, in the same direction, bending the knee slightly, open the joint freely, and dividing all its ligamentous connections, pass the knife flatwise behind the head of the tibia, and cut out a flap from the calf of sufficient size to cover well the condyles of the femur.

§ 2. *Circular operation.—Velpeau's method.*—1st, make a circular incision around the limb, from three to four fingers' breadths below the patella, through the integuments only; 2d, dissect them up and reflect them backwards, preserving as much of the subcutaneous fat with the skin, as possible; 3d, the reflected integuments being held back by an assistant, and the knee flexed, carry the knife through the articulation, dividing all its ligamentous attachments, and cut through the nerves, vessels and muscles behind the joint at one stroke, perpendicular to the axis of the limb, and on a line with the reflected integuments.

§ 3. *Oval operation.—Bauden's method.*—1st, draw with a pen and ink an oblique line starting from the crest of the tibia three fingers' breadths below the patella and running backwards and upwards to the popliteal space, and terminating two fingers' breadths below the line of the articulation, and thence down the opposite side of the limb to the

point from which it started; 2d, follow this line with the knife, dividing the integuments only, which should be dissected up as far as the line of the articulation and reflected upwards. The disarticulation is then effected as in the circular operation, the joint being opened from the front.

Pl. 27.

Fig. 1.

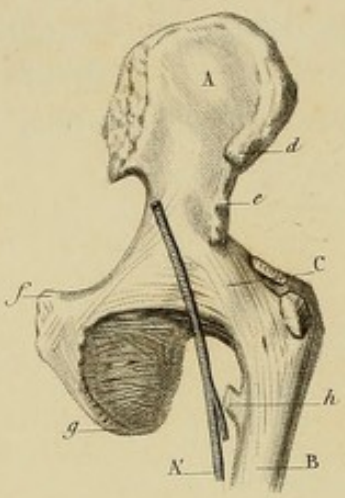


Fig. 2.

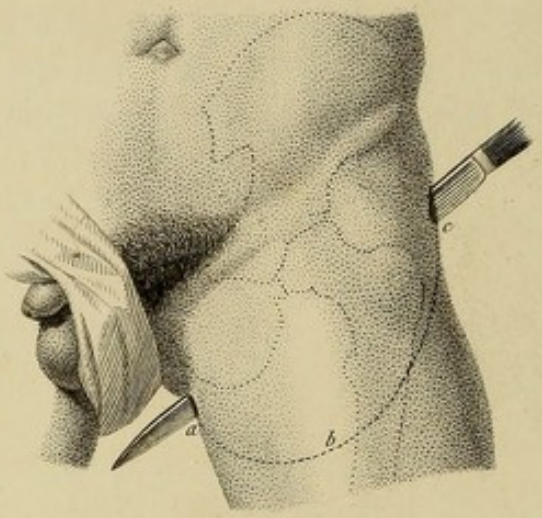


Fig. 3.

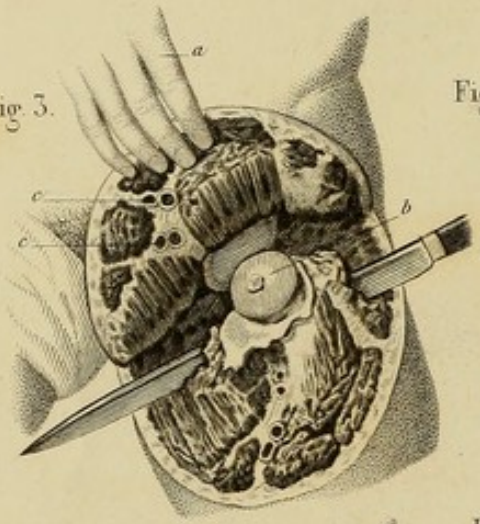


Fig. 5.

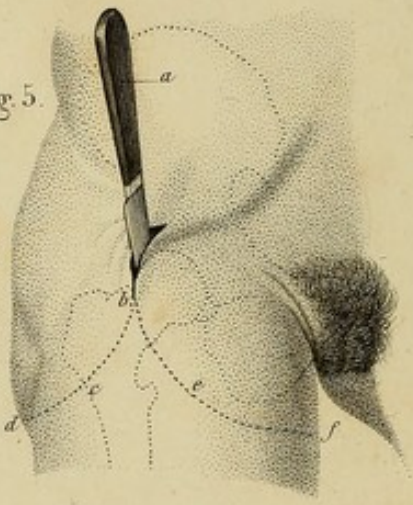


Fig. 4.

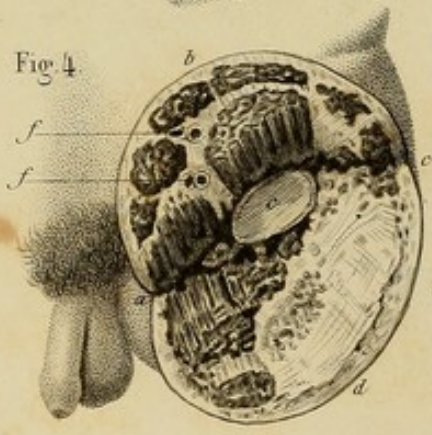


Fig. 6.

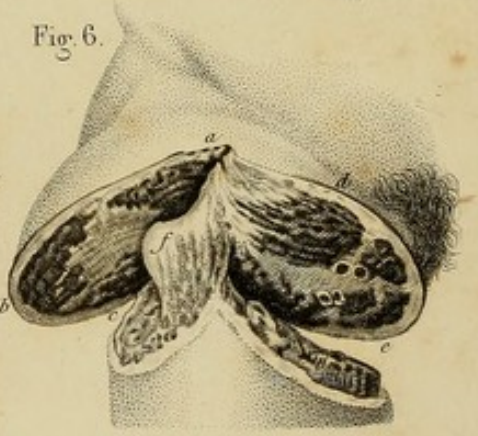


Plate XXVII.

AMPUTATION AT THE HIP-JOINT.

SURGICAL ANATOMY.

Fig. 1. A, internal iliac fossa; A′, femoral artery; B, the femur; C′, head of the femur covered by the capsular ligament; *d*, anterior superior spinous process of the ilium; *e*, anterior inferior spine of the ilium; *f*, spine of the pubis; *g*, tuberosity of the ischium; *h*, trochanter minor.

The coxo-femoral articulation is formed by the acetabulum and the head of the femur; the head of the femur is not completely received into the acetabulum, but is maintained there by a large and strong capsular ligament, and also by a round ligament which is attached to the bottom of the cavity. The capsular ligament is attached to the anterior inferior spine of the ilium, and around the margin of the acetabulum; to disarticulate easily the head of the bone, we must sweep the knife around the acetabulum, cutting the attachments of the ligament close to the margin of the cavity. The plane of the circle formed by the brim of the acetabulum looks a little obliquely downwards and forwards, and hence it projects farther over the head of the femur posteriorly than in front; it is necessary to bear this arrangement in mind in dividing the capsular ligament from behind.

In order to find the articulation, we must be guided by the following anatomical facts:

1st. The anterior inferior spinous process of the ilium is three quarters of an inch above the superior margin of the acetabulum; the anterior superior spinous process is about an inch and three quarters above the same point, and three quarters of an inch to its outer side;

2d. The subject being erect, a line drawn from the anterior superior spinous process of the ilium, to the tuberosity of the ischium, crosses the acetabulum at the junction of its posterior with its two anterior thirds;

3d. The anterior border of the acetabulum is from an inch to an inch and a quarter to the outer side of the spine of the pubis;

4th. The axis of the horizontal ramus of the pubis, extended by an imaginary line, crosses the acetabulum at the junction of its superior with its middle third;

5th. The superior border of the trochanter major is on a level with the upper third of the cavity of the joint.

This articulation, superficial in front, where it is only covered by the inferior extremities of the psoas and iliac muscles and the vessels, is protected inwardly and behind by a considerable muscular mass; exteriorly the muscular parts have little volume.

The femoral artery A′ passes in front of the articulation, on a level with the junction of the middle third of the head of the femur with its internal third; lower down it approximates the bone more closely, where it passes behind it to become the popliteal artery.

OPERATIONS.

Fig. 2. *Disarticulation of the thigh.—Flap method.*—The knife, plunged from without inwards, is about to cut out the anterior flap, *a b c.*

Fig. 3. The same operation. The hand of an assistant, *a*, raises the anterior flap; the head of the femur, *b*, is luxated, and the knife, passed behind it, is cutting out the posterior flap; *c c*, cut ends of the femoral vessels.

Fig. 4. Appearance of the wound after the operation, *a b c*, anterior flap; *a d c*, posterior flap; *e*, acetabulum; *ff*, cut ends of the femoral vessels.

Fig. 5. The same operation with lateral flaps. The knife, *a*, is passed in such a manner as to cut successively two flaps; one internal, *b c f*, the other external, *b c d*.

Fig. 6. Result of this method. The internal and external flaps being cut, we have only to disarticulate the femur, *f*.

MODES OF OPERATING.

AMPUTATION AT THE HIP-JOINT.

§ 1. *Operation with one flap.—Manec's method.*—The patient being placed in a convenient position, and the left limb selected for the operation, the point of the knife is entered midway between the spine of the ilium and the trochanter major, and carried obliquely from above

downwards, in such manner as to graze the anterior part of the neck of the femur, and to come out about an inch below, and in front of the tuberosity of the ischium. Then, by cutting downwards, and parallel with the femur, a large semi-lunar flap is made in front from four to six inches in length. An assistant immediately lifts up the flap, and compresses the femoral artery, which is contained in its substance; then, placing the point of the knife upon the articulation, the capsule of the joint is divided in at least one half of its circumference, and very near to the acetabulum, as if we wished to cut across the middle of the head of the femur, without attempting to enter the articulation. This having been done, the limb is abducted in order to luxate it, after which the knife is passed behind the head of the femur, and divides the remainder of the capsule and the glutæi muscles. The articulation being passed through, the operation is concluded as in the circular method.

The flap operation has been variously modified; to prevent hæmorrhage, Larrey and Delpech tie the artery before making the anterior flap. Plantade and Ashmead cut the flaps from without inwards, towards the deeper parts. Lenoir, after having cut out an anterior flap, makes a circular incision posteriorly, before completing the disarticulation. Lalouette and Delpech make an internal instead of an anterior flap, with this difference, that Lalouette makes his flap after disarticulating, while Delpech transfixes and cuts out his flap, and disarticulates afterwards.

§ 2. *Operation by double flap.—Lisfranc's method, with two lateral flaps.* (Fig. 5 and 6.)—The patient must be laid upon his back with the tuberosities of the ischia projecting slightly beyond the edge of the bed, and the limb held in a position between abduction and adduction. Then having determined by the anatomical rules laid down, the anterior and external side of the articulation, the operator holding perpendicularly a long double-edged knife, introduces it at this point, with its lower edge looking downwards towards the great trochanter. As the point of the knife enters, it should be carried around the head of the femur, on its outer side, whilst its handle is inclined upwards and outwards, and pushed steadily on in this direction so that it perforates the integuments a few lines below the tuberosity of the ischium. While this is being done, an assistant grasps the tissues over the trochanter and carries them outwards, in order to assist in the formation of the external flap, and the knife is carried downwards and outwards with a

slightly sawing motion, around the great trochanter, and along the femur, cutting out a flap from three to four inches in length, *a b c*. Fig 6.

The first flap being thus made, the operator grasping the tissues on the inside of the thigh and carrying them inwards, introduces the knife below the head of the femur, and on the inner side of its neck, holding it in a perpendicular position. As it enters, the point of the knife should pass around the neck of the femur and come out at the lower angle of the wound already made, without coming in contact with the bones of the pelvis; it is then carried downwards along the femur, and avoiding the lesser trochanter, so as to make an internal flap (Fig. 6), of the same length as the external.

The flaps being drawn aside by the assistants, and the arteries tied, the surgeon grasps the femur with his left hand, and holding the knife perpendicularly on the inner side of the head of the bone, cuts the capsular ligament without attempting to penetrate the articulation. The joint being opened, the disarticulation is concluded by cutting the fibrous and muscular tissues which remain.

§ 3. *Oval operation.—Cornuau's method.*—1st. The patient being placed on the healthy side, the surgeon enters the point of the knife an inch above the great trochanter, and from this point makes an oblique incision backwards, outwards and downwards to a point below the tuberosity of the ischium. 2d. The knife placed in the superior angle of the wound, makes a similar incision forwards and inwards. 3d. The muscles are divided on the outside as deeply as possible, and the limb being luxated outwards, the knife enters the articulation externally and is carried through the joint to the inner side of the femur.

One assistant compresses the artery in the anterior flap, another lifts up the flesh on the external side, while the surgeon terminates the operation by dividing the soft parts between the two incisions in the form of a V.

The circular method is inconvenient, and rarely used for amputating at the hip joint.

Pl. 28.

Fig. 3.

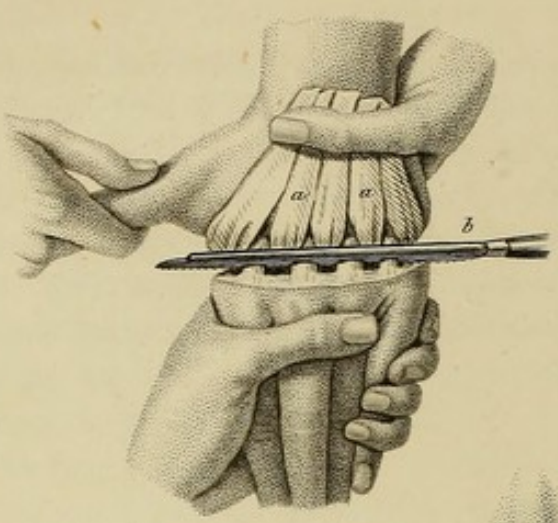


Fig. 2.

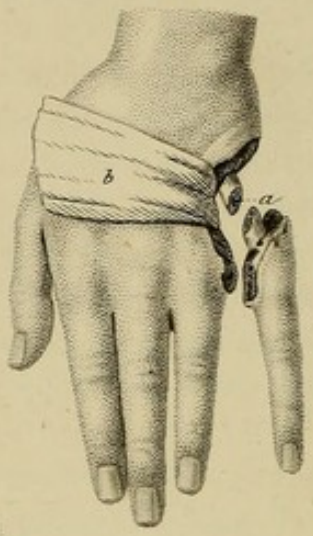


Fig. 1.

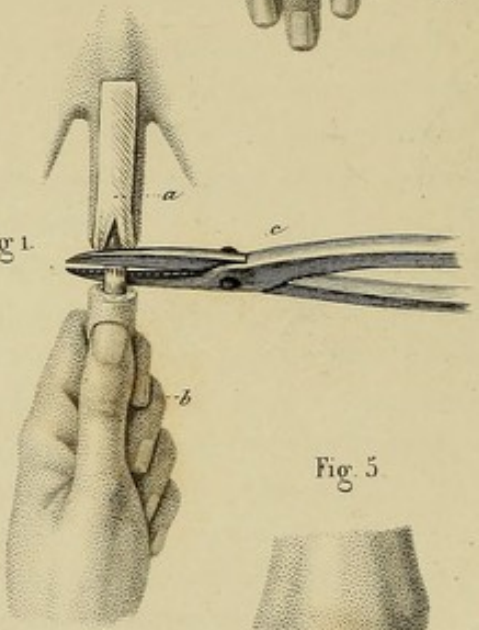


Fig. 4.

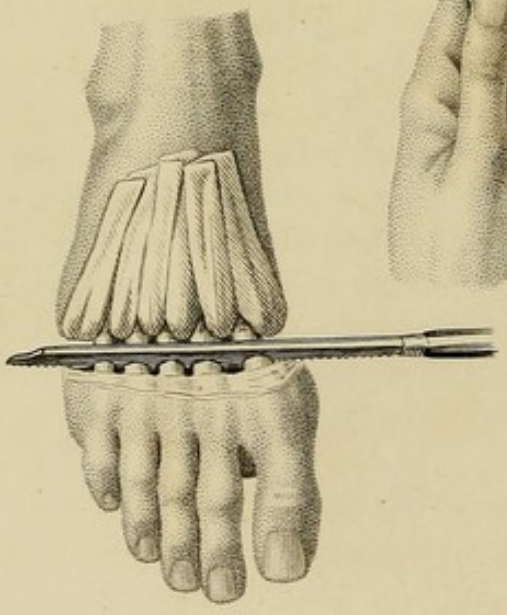
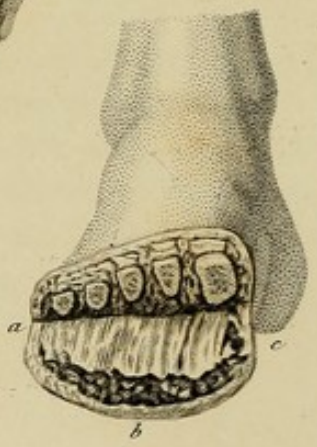


Fig. 5.



AMPUTATIONS IN THE CONTINUITY OF LIMBS.

Plate XXVIII.

AMPUTATIONS OF THE FOOT AND HAND.

OPERATIONS.

Fig. 1. *Amputation of a finger.*—*a*, a linen bandage for retracting the soft parts; *b*, the left hand of the operator grasping the extremity of the finger, while the right hand, holding a pair of Liston's forceps, *c*, effects the section of the bone with a single cut.

Fig. 2. *Amputation of the fifth metacarpal bone.*—*a*, the bone sawed obliquely from above downwards, and from without inwards, the hand being in a state of pronation; *b*, a compress for protecting the soft parts.

Fig. 3. *Amputation of the four metacarpal bones.*—*Circular method; a a*, linen bands between the bones to retract the soft parts, while the saw divides the bones.

Fig. 4. *Amputation of the metatarsal bones.*—Method with a plantar flap; bandages are placed between the bones as in the amputation of the metacarpal bones.

Fig. 5. The same method.—Appearance after the operation; *a b c*, shape of the plantar flap.

MODES OF OPERATING.

§ 1. *Amputation of the fingers* (Fig. 1).—The circular method is usually adopted. After the circular incision of the skin, it must be retracted after dissecting it up for three or four lines above the first incision; the fibrous tissues and particularly the tendinous sheaths on the palmar aspect of the finger are then divided, and the bone sawn through by a watchmaker's saw, or cut with Liston's nippers. The skin being drawn over the bone, will unite with a transverse cicatrix, which is less likely to be injured by flexion of the fingers.

§ 2. *Amputation of a metacarpal bone and the finger attached to it.*—In these cases, as in disarticulation, the oval method may be most ad-

vantageously employed. When the bone is bare, a compress or piece of wood is placed behind it to protect the soft parts from the saw. A small saw should be used, and should be held obliquely from above downwards, and from without inwards. For the metacarpal bone of the thumb, we hold the saw perpendicularly, as in the operation upon the fingers. If we operate by the oval method in amputating the third or fourth metacarpal bone alone, it is very difficult to use the saw. In such cases Velpeau uses Liston's nippers, and experience proves that the cicatrisation is as complete and rapid when the bone is divided in this way, as by any other means.

§ 3. *Simultaneous amputation of the four metacarpal bones* (Fig. 3.)—A palmar flap is made from the palm of the hand, and the operation continued in the same way as in disarticulating the four fingers. (See pl. 20, fig. 2.) Then, with a straight bistoury, the muscles and periosteum are separated from the bones, and a five tailed retractor placed in the interosseous spaces, to protect the soft parts from the saw.

§ 4. *Amputation of one metatarsal bone and the toe attached to it.*—The same rules apply to this operation, as in the amputation of the metacarpal bones, with this exception, the bone is denuded of the soft parts only at the exact point where it is to be divided. The oval method is the most convenient, and is generally adopted. For the first and fifth metatarsal bones they should be sawn obliquely, the point resting against the adjoining metatarsal bone; by this means we prevent its projecting against the flap.

§ 5. *Simultaneous amputation of all the metatarsal bones* (fig. 4 and 5).—A plantar flap is first cut as in Chopart's operation; the two extremities of the base of the flap are united by a semi-circular incision, which crosses the dorsal aspect of the foot, dividing the skin and extensor tendons a few lines below the place where it is intended to saw the bone. The skin should then be retracted, and the bones carefully denuded with a straight bistoury, and the operation concluded by sawing through these bones, beginning upon the dorsum of the foot.

Fig. 3.

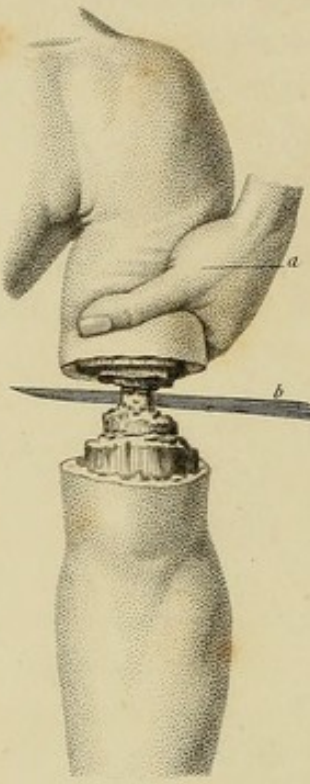


Fig. 4.

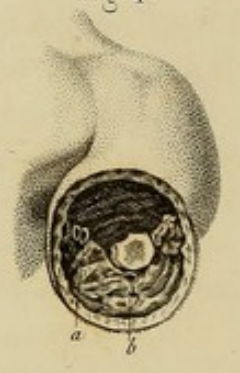
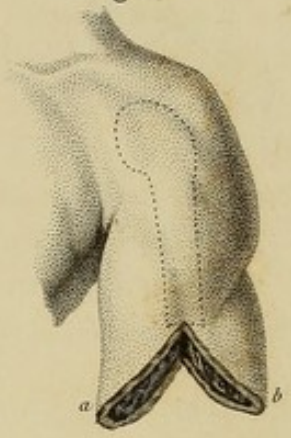


Fig. 5.



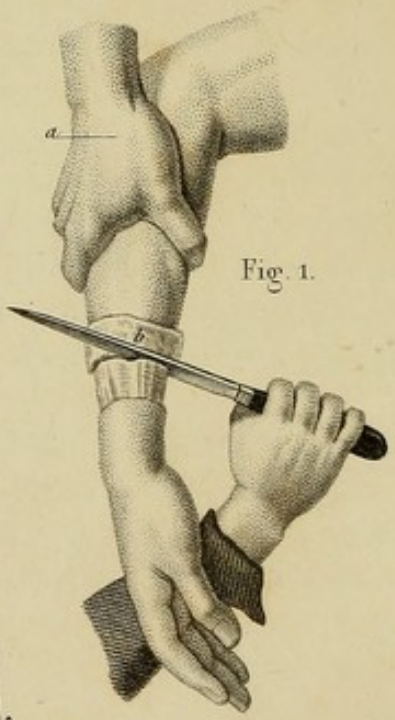


Fig. 1.

Fig. 2.

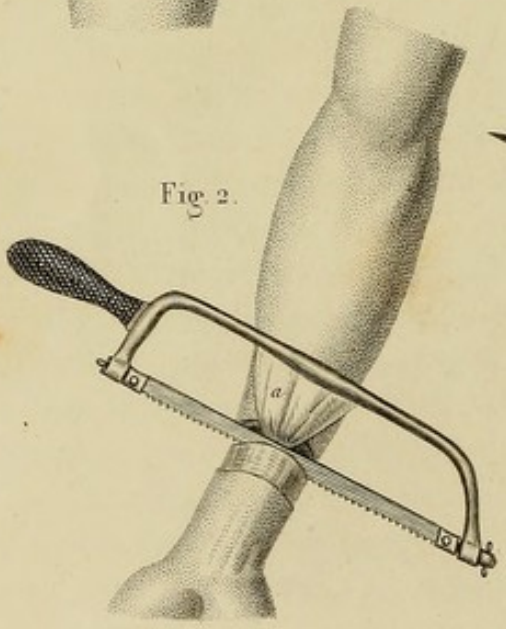


Plate XXIX.

AMPUTATIONS OF THE FORE-ARM AND ARM.

OPERATIONS.

Fig. 1. *Amputation of the right fore-arm.—Circular and ordinary method.—a*, the hand of an assistant supporting the fore-arm. The surgeon standing on the outside of the limb, and holding the knife, is incising the muscles.

Fig. 2. *The same operation.* A three tailed retractor, *a*, passed between the bones, serves to retract the soft parts and protect them from the saw.

Fig. 3. *Amputation of the left arm.—Circular and ordinary method.—a*, the hand of an assistant drawing up the soft parts, while the surgeon, with the knife, *b*, cuts the deep muscles.

Fig. 4. Appearance of the stump, after the operation; *a*, the vessels, *b*, the humerus.

Fig. 5. *Same operation.—By double flaps.—Velpeau's method.*—The operation concluded; *a*, the internal flap; *b*, the external flap.

MODES OF OPERATING.

§ 1. *Amputation of the fore-arm.—Circular and ordinary method.*—The fore-arm being held by assistants in a position between pronation and supination, the surgeon holding a catlin, stands upon the inner side of the limb, if he operates upon the left fore-arm; upon the outer side, if upon the right. The operation is performed as follows:

1st. Make a circular incision which will divide the skin and subcutaneous cellular tissue down to the aponeurosis. Divide the cellular bands, and turn up the skin like the cuff of a coat, if it should not easily retract. If the limb is large and conical, it may be necessary to make a lateral incision in the skin.

2d. Divide circularly the muscles, with a sawing motion, at the border of the flap of skin which is turned up. The deep muscles between the bones must be divided by introducing the point of the knife, and

carefully cutting all the soft parts in the interosseous space. To do this the knife should be entered on the dorsal aspect of the radius, and carried around and between the bones by a figure of 8 incision. (See plate 30, fig. 2, and 2 amputation of the leg).

3d. A retractor with three ends must then be introduced into the interosseous space to draw up the soft parts. At the point where the bones are denuded, the surgeon draws the saw slowly at first across the radius and ulna, taking care to saw through the radius first, as the ulna, being more closely attached to the arm, serves as a support for the limb.

4th. The radial and ulnar, with the anterior and posterior interosseous arteries, are now tied. Then the skin, being drawn down, is so disposed as to form a transverse cicatrix.

This operation can also be performed by flaps, or by the oval method. In Græfe's method by a single flap, the flap is cut from the anterior portion of the fore-arm. By Vermale's method, with an anterior and posterior flap, a risk is run of exposing the ends of the bones at the angles of the wound. The oval method of Baudens offers no advantages over that usually adopted.

§ 2. *Amputation of the arm.—Circular and ordinary method* (fig. 3 and 4).—The arm being held by an assistant at a right angle with the trunk, the surgeon, holding the knife, stands on the outer side of the limb, and performs the operation according to the following rules:

1st. The skin and subcutaneous cellular tissue are cut circularly down to the aponeurosis. The skin is usually easily retracted.

2d. After which the surgeon, following the margin of the skin, cuts the muscles, with a sawing motion, down to the bone. The assistant again retracts the skin, and a second incision, carried as high up as possible, divides the deep muscles down to the bone, care being taken to cut through the periosteum and the radial nerve, which is in a sulcus in the bone.

3d. A doubled tailed retractor is now passed around the limb, and the bone sawed through. The brachial artery, and its branches, if necessary, are now tied.

Double flap method.—This amputation may also be performed by double flaps, either anterior and posterior, or lateral; Velpeau prefers the lateral.

Fig. 1.



Fig. 2.



Fig. 2 bis



Fig. 4.

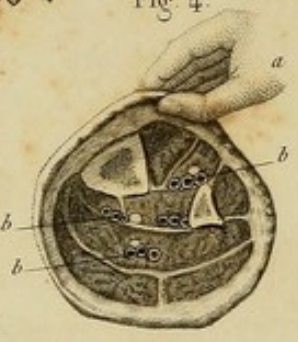


Fig. 3.

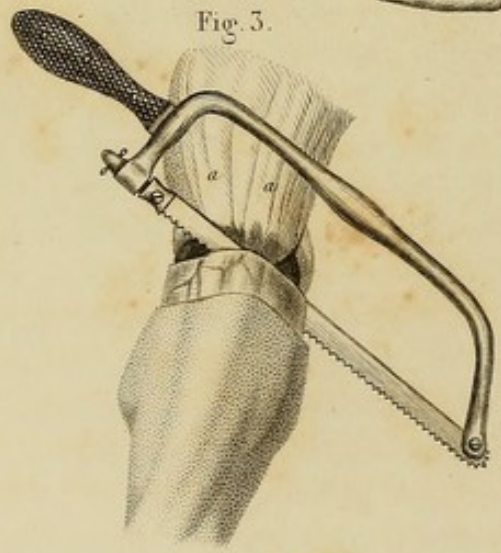


Fig. 5.

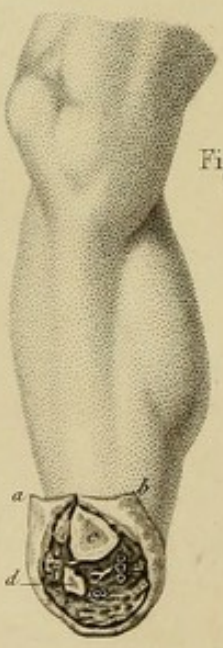


Plate XXX.

AMPUTATION OF THE LEG.

OPERATIONS.

Fig. 1. *Amputation at the place of election.—Circular and ordinary method.—a, b, c,* circular incision of the integuments; *d,* flap of skin turned up. The surgeon stands on the inner side of the limb, and cuts the muscles with a double-edged knife.

Fig. 2 and 2 *bis. The same operation.*—Incision of the deep muscles surrounding the bone.

Fig. 3. *The same operation.*—A three tailed retractor, *a a,* passed between the bones, supports the soft parts, and protects them from the saw.

Fig. 4. *Appearance of the wound after the preceding operation.*—The hand of an assistant, *a,* holds up the flap formed by the integuments; *b b b,* vessels of the leg.

Fig. 5. *Amputation of the leg at its inferior third.—Lenoir's method.*—Appearance of the wound after the operation. *a, b,* angular flaps formed by the division and dissection of the skin making a kind of cuff divided in front; *c,* the tibia; *d,* the fibula.

METHODS OF OPERATING.

§ 1. *Amputation of the leg at the most desirable point, two or three fingers breadth below the tuberosity of the tibia.—Ordinary method.*—(Fig. 1, 2, 2 *bis,* and 3.) The patient lying down, the leg, projecting beyond the bed, should be held at a convenient distance from the other by the assistants; the surgeon, grasping a catlin, stands on the inner side of the limb.

1st. A circular incision is made through the skin and subcutaneous cellular tissue. This incision should commence at the crest of the tibia, and be concluded without removing the knife. After this division, the surgeon dissects up the skin for an inch and a half or two inches, and turns it up like a cuff.

2d. Beginning at the border of the skin, which is turned up, with a

sawing motion of the knife the remainder of the flesh is cut through to the bone.

3d. The muscular fibres in immediate contact with the bones are divided by a figure of 8 incision, which is effected as follows (fig. 2): the edge of the knife is placed on the fibula at the outer side of the limb, carried across it and thrust through the interosseous space where it is made to cut upon the tibia *a*, and the inner surface of the fibula *b*, and brought out as at *d*. Then (fig. 2 *bis*) it is withdrawn, and applied to the posterior aspect of the limb, acting first upon the fibula as at *c*, and the same process being repeated as before, it is brought out finally as at *d*. The retractor is then applied in the usual manner for the protection of the soft parts.

4th. The surgeon now taking the saw, marks the point at which the tibia is to be divided with the thumb nail of his left hand, and drawing the saw towards himself, slowly at first, until it is fairly engaged, then elevates its handle so as to make it act upon the fibula at the same time, and having divided it entirely, finishes with the tibia. The arteries requiring ligature (fig. 4), are the anterior and posterior tibial, and the peroneal, and sometimes the sural branches.

Remarks.—Roux advises the surgeon to saw the fibula a little higher up than the tibia, in order to prevent its subsequent protrusion from the stump. Many surgeons saw off the anterior angle of the tibia, after the section of the bones. Sanson makes an oblique section of it, inwards and upwards. Sabatier recommends an oblique incision of the integuments on the calf of the leg, on account of the greater retraction of the muscles at this point, and, when the skin is turned up, concludes the operation by the circular method.

The operation by single flap, by double flap, or the oblique or oval method, may all be employed at the place of election in exceptional cases where the circular operation is not applicable.

§ 2. *Amputation at the inferior third of the leg.—Lenoir's method.* (Fig. 5.) The surgeon standing on the inner side of the limb makes a circular incision through the skin and subcutaneous cellular tissue, about an inch and a quarter below the place where it is intended to saw the bones. A vertical incision of the same length is also made along the crest of the tibia. This flap is then dissected up, and when turned up has the appearance of a collar open in front. The muscles are now divided down to the bone, beginning at the margin of the flap, their remaining fibres in the interosseous space are then cut, a three tailed retractor passed between the bones, and they are sawn through.

Pl. 31.

Fig. 1.

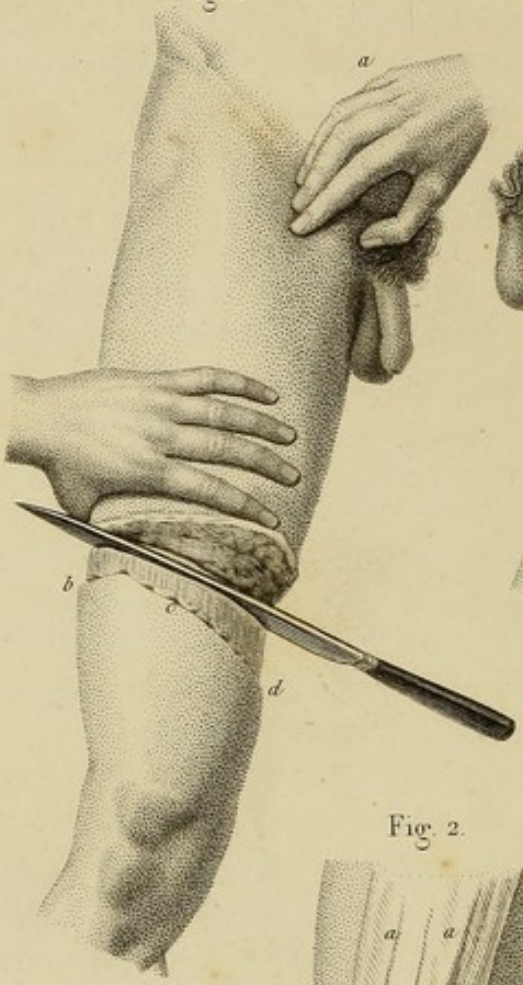


Fig. 4.

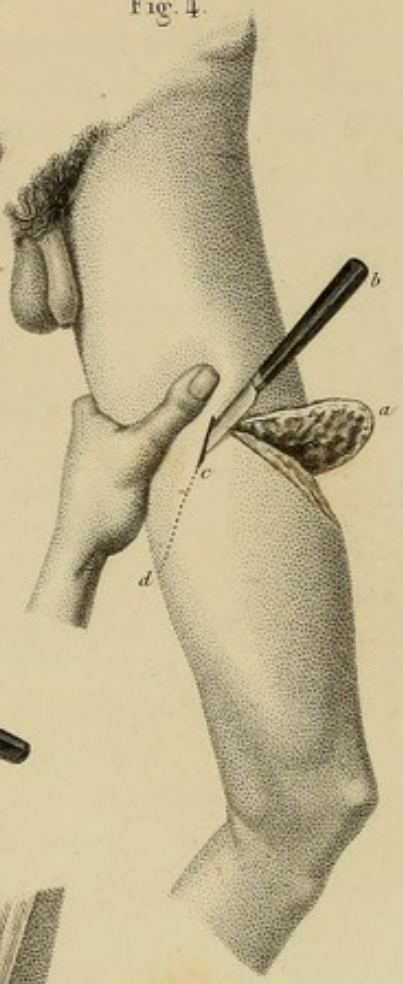


Fig. 2.

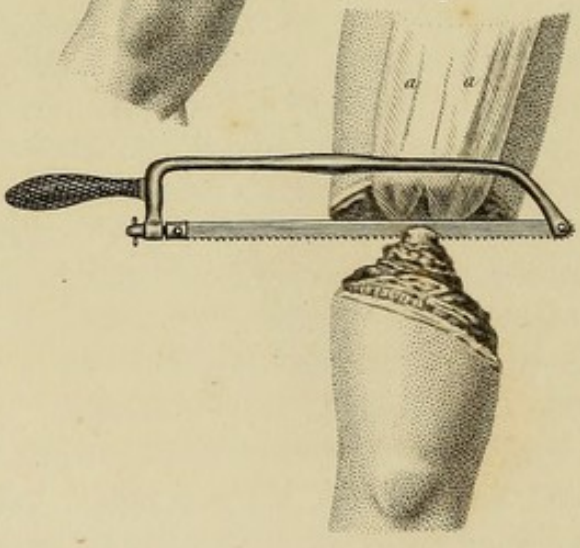


Fig. 3.

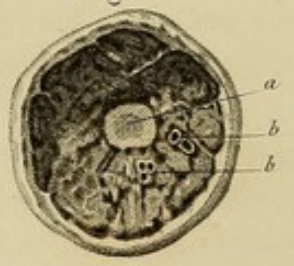


Plate XXXI.

AMPUTATION OF THE THIGH.

OPERATIONS.

Fig. 1. *Circular operation.—Ordinary method.*—The hand of an assistant, *a*, compresses the femoral artery; *b*, *c*, *d*, circular incision of the integuments.

Fig. 2. The same operation. The muscles being incised to the bone, a split retractor, *a a*, serves to draw up the soft parts and protect them from the saw.

Fig. 3. The same operation concluded; appearance of the stump, *a*, section of the femur; *b b*, the open femoral vessels.

Fig. 4. *By double flaps.—Sédillot's method.*—*a*, the first flap drawn aside; the knife, *b*, entered obliquely, and following the line, *c*, *d*, is cutting the second flap.

METHODS OF OPERATING.

Circular and ordinary method (fig. 1, 2, and 3).—The patient lying on his back, the thigh is separated to a convenient distance from the other, slightly flexed upon the pelvis, and firmly held in this position by the assistants. The surgeon stands upon the inner side of the limb.

1st. Make a circular incision through the skin and subcutaneous cellular tissue, a short distance above the knee, and four or five fingers breadth below the place where it is intended to saw the bone. An assistant retracts the skin, while the surgeon divides the fibres of cellular tissue by which it is attached.

2d. Beginning at the margin of the retracted integuments, the superficial muscles are now cut; from the point of their retraction, the surgeon divides the deeper muscles down to the bone; a split retractor is passed around to protect the soft parts, and the bone is sawn through as usual (fig. 2).

3d. The *femoral artery* lying beneath the sartorius muscle, the *superficial* and *deep muscular*, and the *perforating arteries* are now to be tied. The edges of the wound should be brought together so as to obtain an oblique cicatrix.

If desirable, the double flap or the oval method may be adopted for the amputation of the thigh.

Pl. 32.

Fig. 1.

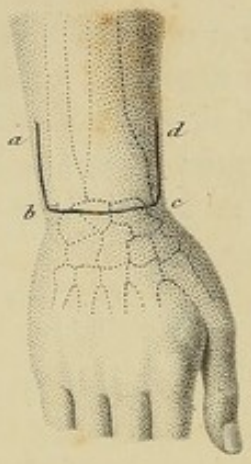


Fig. 4.

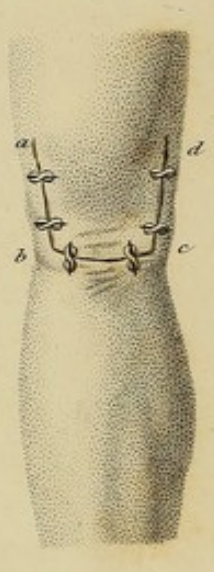


Fig. 2.

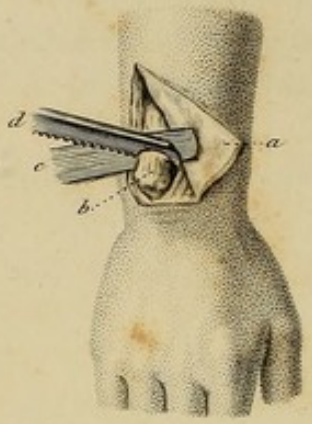


Fig. 5.

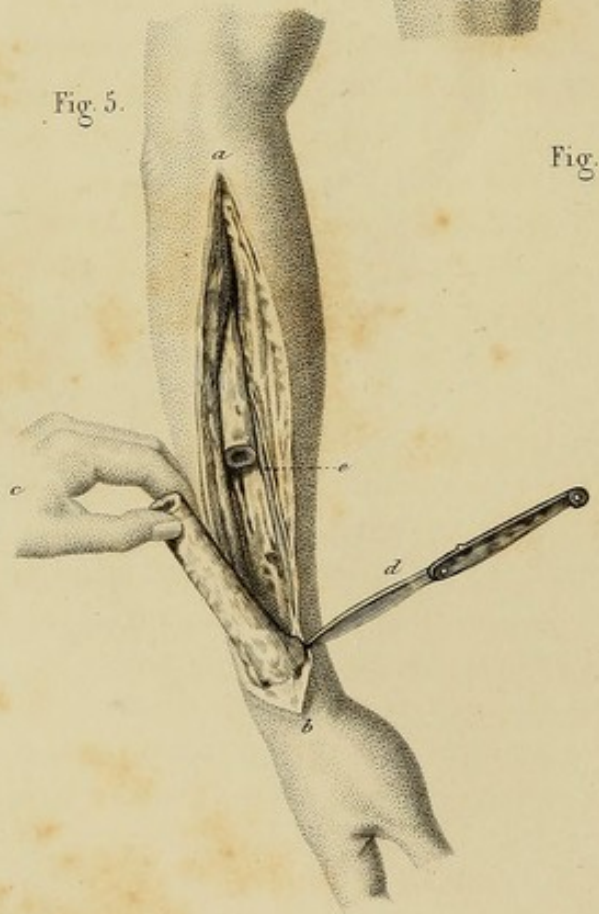


Fig. 3.

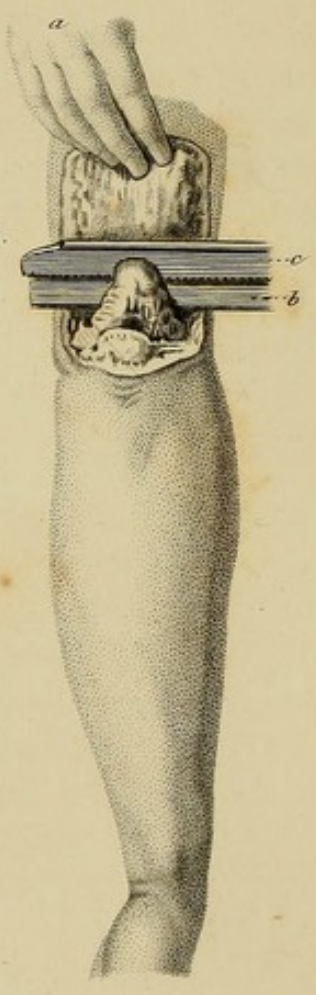


Plate XXXII.

EXSECTIONS PERFORMED IN THE SUPERIOR EXTREMITY.

OPERATIONS.

Fig. 1. *Exsection of the wrist-joint.—Velpeau's method.—a, b, c, d,* quadrilateral cutaneous flap cut out from the posterior face of the radio-carpal articulation.

Fig. 2. *Exsection of the inferior extremity of the ulna.—a,* triangular flap of skin drawn aside; *b,* inferior extremity of the ulna; *c,* a thin piece of wood placed beneath the bone to protect the soft parts from the saw, *d.*

Fig. 3. *Exsection of the elbow-joint.—Moreau's method.—a,* the hand of an assistant holding up a quadrilateral flap, which has been dissected from below upwards from the posterior aspect of the joint; *b,* a thin slip of wood placed beneath the humerus while the saw, *c,* divides the bone.

Fig. 4, The same operation concluded. *a, b, c, d,* the quadrilateral flap brought back to its place, and re-united by the twisted suture.

Fig. 5. *Extirpation of the radius.—a, b,* a long incision made upon the outer side of the forearm down to the radius; *c,* the left hand of the surgeon raising the inferior extremity of the radius, while the right hand holding a bistoury, *d,* completes the disarticulation; *e,* the radial artery accompanied by the radial nerve.

METHODS OF OPERATING.

§ 1. *Exsection of the metacarpo-phalangeal articulation.*—The head of the metacarpal bone, the end of a phalanx, or both may be removed, according to the nature of the case.

Make an oblique incision on the dorsal aspect of the metacarpal bone, commencing about half an inch beyond the point where it is to be divided, and extending it to the commissure of the fingers; a similar incision should then be made on the other side, and the two will form a V

shaped flap with its base toward the finger. After dissecting and turning up this flap, the extensor tendon should be drawn aside, without dividing it, and the interosseous muscles detached from either side of the bone. The joint is then opened by cutting through the lateral ligaments, care being taken not to injure the flexor tendons. Luxate the phalanx backward, and carefully separate the diseased from the sound parts. After slipping a piece of wood or a card under the bone to protect the soft parts, it may now be sawn through, or cut with Liston's forceps. In operating upon the index or little finger, it is better to make the flap on the free side of the joint, and thus to avoid exposing the extensor tendon.

§ 2. *Extraction of the first phalanx.*—This operation having been performed successfully by Velpeau upon the thumb, without injuring the movements of the last phalanx, might possibly be applied to the phalanges of the fingers. Make an incision upon the dorsum of the finger, commencing half an inch above the metacarpo-phalangeal articulation, and extend it one-third of an inch below the articulation of the first and second phalanx. Dissect up the skin, and drawing aside the extensor tendon, cut through the lateral and anterior ligaments without injuring the flexor tendon. Luxate the bone upward, carefully separate it from the soft parts, and its extraction is then easily effected by traversing the inferior articulation.

§ 3. *Exsection of the metacarpal bones.*—Make a longitudinal or crucial incision upon the dorsum of the metacarpal bone which is to be removed; draw aside the extensor tendon, separate the interosseous muscles from the bone, and if it is the superior portion of the metacarpal bone which is to be removed, cut through the carpo-metacarpal articulation; if the inferior, the metacarpo-phalangeal. Pass a small compass beneath the bone to protect the soft parts, and divide it with Liston's forceps, or the chain saw; the operation is then concluded by drawing upward the exsected portion and separating it from the soft parts.

The metacarpal bone of the thumb or the little finger should be sawn obliquely, to prevent the sharp angle from injuring the flap. (v. pl. 28, fig. 2.)

§ 4. *Exsection of the wrist joint*—The inferior extremity of the radius, or of the ulna, or the carpal extremities of both bones, may be removed, according to the necessities of the case.

I. *Exsection of the inferior extremity of the ulna.*—(Pl.32, fig. 2.) —The hand being carried outwards, a longitudinal incision is made

along the internal border of the ulna, and terminated inferiorly by a transverse incision across the back of the joint. A triangular flap, *a*, is then carefully dissected up, and the tendons being drawn aside, and the vessels carefully avoided, the bone *b* is denuded of its soft parts and disarticulated with the bistoury. A small slip of wood, *c*, is passed beneath the extremity of the bone, which is then sawn through, as at *d*.

II. *Exsection of the inferior extremities of the radius and ulna* (pl. 32, fig. 1).—1st. The hand being pronated and held firmly upon some solid surface, two longitudinal incisions are made along the borders of the radius and ulna *a b*, *c d*. A transverse incision across the back of the joint unites the lower extremities of these *b c*, and (2d) the quadrilateral flap, *a b c d*, thus circumscribed, is dissected up and turned backwards. 3d. The disarticulation is then effected, the tendons surrounding the two bones being detached with as little injury as possible, and the radial and ulnar arteries in front being especially cared for; 4th, pass a thin slip of wood or pasteboard beneath the bones, and complete their section by the saw applied to both at the same time.

By Dubled's method, two longitudinal incisions alone are made, one upon the radius, and the other upon the ulna. By the internal incision, the ulna is extirpated; and through the external, the radius is disarticulated and removed.

To the longitudinal incisions of Dubled, Roux adds two transverse incisions, which are carried across the dorsum of the wrist to the edges of the extensor tendons, thus leaving a portion of undivided integument along the back of the wrist.

Velpeau's method is similar to that above described, with the exception that he dissects his quadrilateral flap from above downwards, instead of from below upwards.*

5. *Exsection of the elbow joint.*—One or all the bones composing this joint may be removed, according to the exigencies of the case.

I. *Exsection of the inferior extremity of the humerus* (pl. 32, fig. 3 and 4).—*Moreau's method.*—1st. The arm being semi-flexed, and

* Experience has proved that the removal of the lower end of the radius alone is of doubtful utility, the hand being permanently carried outwards out of the axis of the forearm by muscular contraction, and the subsequent removal of the lower end of the ulna being rendered necessary.

The thin slip of wood or pasteboard recommended in the text, is advantageously replaced by a slip of gutta percha of suitable size and thickness; its toughness and flexibility adapting it better to the protection of the soft parts from the action of the saw.—Eds.

the posterior face of the articulation turned towards the surgeon, two longitudinal incisions, each about two inches and a half in length should be carried upwards along the humerus, one from the outer side of the external condyle, the other from the inner side of the internal condyle; 2d, these two incisions should then be united by a transverse section through the skin and triceps muscle immediately above the olecranon; a quadrilateral flap is thus formed, which being dissected from below upwards, must be supported by an assistant, *a* (fig. 3); 3d, the surrounding parts, and the ulnar nerve divested of its fibrous sheath, should then be carefully isolated from the bone, and drawn inwards by an assistant; 4th, the bone being carefully denuded, a slip of wood or metal, *b*, is slid under it to protect the soft parts from the saw, *c* (fig. 3); the separated portion of the bone is then cut loose from its various adhesions, and the joint opened from behind.

II. *Exsection of the superior extremities of the bones of the fore-arm.*—Moreau's method may be adopted in this operation by extending the external lateral incision along the radius as far as the point where the bone is to be divided. The radius is then isolated from the ulna and the soft parts; a thin slip of wood, as usual, is slid beneath it, and the bone is then sawn through. If the ulna is to be removed, the internal lateral incision is prolonged, and the operation continued as with the radius, the attachments of the *brachialis anticus* being injured as little as possible.

III. *Extirpation of the radius* (pl. 32, fig. 5).—1st. Make a longitudinal incision along the anterior and external border of the radius, *a b*, so as to lay bare the bone; 2d, after denuding it to the soft parts, a small slip is passed beneath it, about its middle, if the ordinary saw is used, if the chain saw, this is unnecessary; 3d, each fragment of the radius is then isolated, and disarticulated below and above, the neighboring vessels and nerves being carefully avoided.

§ 6. *Exsection of the shoulder joint.—Baudens' method, by simple incision.*—A vertical incision commencing below the coracoid process is made along the anterior border of the deltoid. At each angle of the wound, a transverse section of the muscle is made, without cutting the skin. By this transverse section the lips of the wound are more easily separated, and the joint rendered more accessible.

Malgaigne's method.—A vertical incision, more external than in Baudens method, is made opposite to and carried up to the summit of the coraco-clavicular triangle, which should involve the skin, the mus-

cle, and the capsular ligament. The articulation is thus opened superiorly and anteriorly. The lips of the wound separate very easily, and permit the knife to be carried freely round the head of the bone, the removal of which is easily effected with the chain saw, or the ordinary instrument.

2d. *Various methods by flaps.*—The single flap operation is usually performed in removing the head of the humerus. Moreau and Manne make a quadrilateral flap; the former with an inferior, the latter with a superior base. Morel makes a semilunar flap with its base above. Sabatier prefers a triangular flap with the same base. Malgaigne advises a lateral and posterior flap, after Lisfranc's method of amputating at the shoulder joint. The flap once cut, the articulation is opened, and carefully avoiding the vessels and nerves, the head of the bone is disengaged and turned out. It is then removed with the saw as usual.

§ 7. *Exsection of the clavicle.*—1st. *Exsection of the scapular extremity.*—Velpeau describes as follows, an operation performed by himself in 1828, upon a woman affected with necrosis of the external third of the clavicle: "A crucial incision whose two branches were each about two inches in length was first made; the flaps were then dissected and held back; the acromio-clavicular ligaments and a few fasiculi at the origin of the deltoid and trapezius were then divided, and with the assistance of a thin piece of wood placed beneath the articulation and used as a lever, the diseased bone was raised up and detached from the sound parts. The soft parts were then carefully separated from the bone before and behind, a chain saw slipped beneath it, and it was sawn from within outwards, and afterwards disarticulated."

2d. *Exsection of the sternal end.*—In a peculiar case, Dr. Davie performed this operation by making an incision two inches and a half in length from its inner end, along the axis of the clavicle. The ligaments were then divided as much as possible, and a strip of hammered leather being placed beneath the bone to protect the soft parts, the inner part was sawn through with a Hey's saw about an inch from its articular surface. The bone being sawn through, it was necessary, in order to remove the separated portion, to use the handle of the scalpel as a lever to rupture the interclavicular ligaments which could not

otherwise be reached, and which still retained the bone firmly in its place.*

3d. *Removal of the entire clavicle.*—Mott, of New-York, performed this operation successfully for an osteosarcoma of the size of the two fists. A curvilinear incision was made with its inferior convexity extending from one articulation to the other, beneath the tumor. Another incision was carried from the acromion process to the outer edge of the external jugular vein, dividing the platysma myoides and a portion of the trapezius; a grooved director was passed beneath the bone near the acromion, and it was cut through with a chain saw. The removal of the inner extremity was very tedious and difficult, on account of the size of the tumor, and the degeneration of the adjacent parts.

To facilitate this operation, Velpeau and Malgaigne advise a quadrilateral flap, which should be dissected and turned upwards.

§ 8. *Removal of the scapula.*—Janson exsected a large part of the sub-spinous portion of this bone, for a tumour which was connected with it. The tumour was circumscribed with two elliptical incisions, and the lips of the wound dissected up and turned outwards. The scapula above the spine being healthy, the diseased portion was separated from it with the saw, thus preserving the articulation of the arm.

* This is the extraordinary case reported by Sir Astley Cooper as the only instance within his knowledge of a dislocation of the sternal end of the clavicle backwards. (Dislocations and Fractures, p. 309, Am. Ed., Phil., 1844.) It occurred in a young lady as a consequence of distortion of the spine, and the operation was undertaken for its removal on account of the pressure made by the sternal end of the bone upon the œsophagus, which rendered deglutition almost impossible.—Eds.

Pl. 33.

Fig. 1.





Fig. 2.

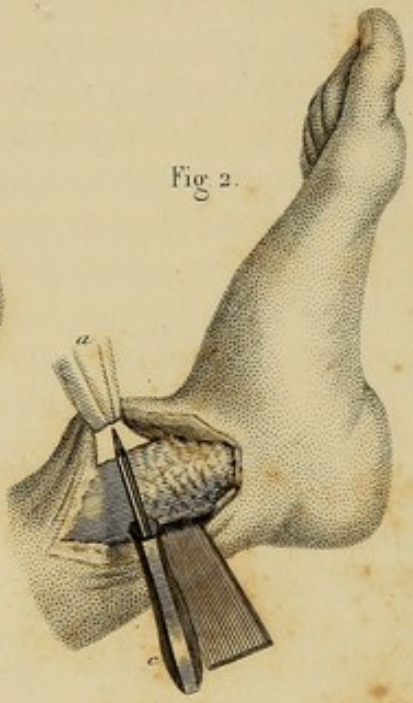


Fig. 3.

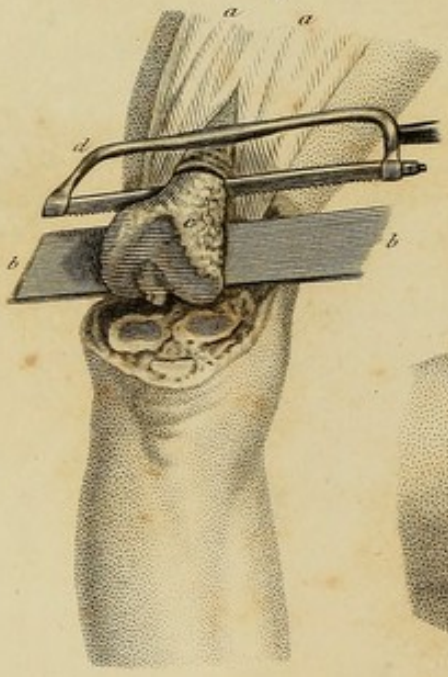


Fig. 4.

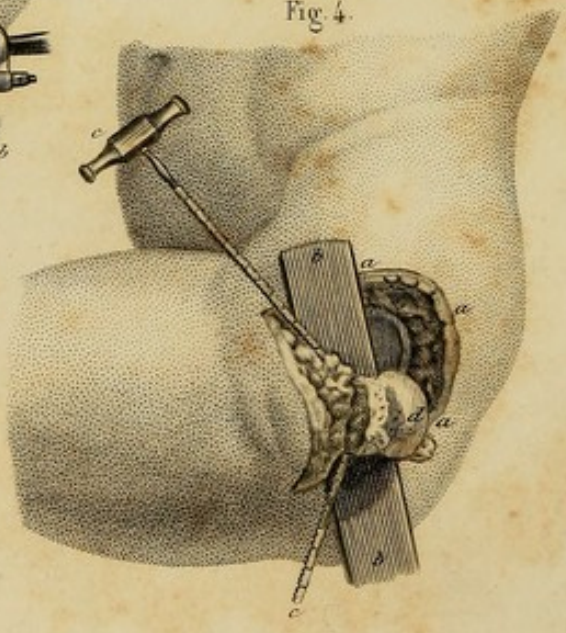


Plate XXXIII.

EXSECTIONS PERFORMED UPON INFERIOR EXTREMITY.

Fig. 1. *Exsection of the lower extremity of the fibula.*—The surgeon holding a chisel, *a*, and a mallet, *b*, is removing the external malleolus.

Fig. 2. *Exsection of the lower extremity of the tibia.*—*a*, a linen retractor drawing up the soft parts in front of the bone; *b*, a thin slip of wood placed behind the soft parts to protect them from the saw, *c*.

Fig. 3. *Exsection of the lower extremity of the femur.*—*a a*, a retractor to draw up the soft parts; *b b*, a slip of wood to protect the parts behind from the saw, *d*; *c*, the lower end of the femur luxated forwards.

Fig. 4. *Exsection of the head of the femur.*—*Sedillot's Method.*—*a a a*, a semilunar incision with its convexity upwards, taking in the great trochanter; *b b*, a slip of wood placed beneath the luxated head of the femur; *c c*, a chain saw cutting the head of the bone, *d*, from within outwards.

METHODS OF OPERATING.

§ 1. *Exsection of the first metatarsal bone.*—The first metatarsal is the only bone upon which the operation of exsection is performed.

1st. *Exsection of the distal extremity of the first metatarsal bone.*—Blandin makes a quadrilateral flap, with its base posteriorly, on the inner side of the foot. This flap being dissected up, the lips of the wound are separated and the extensor tendon drawn aside; the metatarso-phalangeal articulation is then divided, and the head of the bone luxated, while with the bistoury it is separated from the adjacent muscles. The soft parts being properly protected, the diseased portion of the bone is removed by dividing it at right angles with its axis with a narrow bladed saw, or with the chain saw, if preferred. The incisions may be modified to suit special cases.

2d. For the extraction of the first metatarsal bone entire, the base of the quadrilateral flap should be carried up as far as the os scaphoides.

The metatarso-phalangeal articulation being more accessible, should be first divided, and the head of the bone being then raised up, it is denuded of its attachments, and the operation concluded by opening the articulation of the metatarsal with the cuneiform bone. Velpeau prefers sawing through the middle of the bone, and extracting the fragments separately.

§ 2. *Exsection of the bones of the tarsus.*—The cuneiform bones, the scaphoides, but more frequently the astragalus and os calcis have been exsected in cases of caries, luxation, and extensive injury. There are no fixed rules for these operations, they must be performed according to the nature of the case. To separate the bones from each other, it is sometimes necessary to use the gouge and mallet.

§ 3. *Exsection of the ankle joint.*—(Pl. 33, fig. 1, 2.)—*Roux's method.*—1st. Make on the outer side of the fibula a longitudinal incision three inches in length, commencing over the external malleolus, and carry it down to the bone. From the lower part of this incision, make a transverse section of the skin as far forwards as the tendon of the *peroneus tertius.* Dissect up the triangular flap thus formed, and opening the sheath of the *peroneus longus* and *brevis*, push them aside, and avoiding the vessels and nerves, denude the fibula of the soft parts, insinuate a chain saw between the tibia and fibula, and saw the bone from within outwards. This being effected, make use of the extremity of the fibula as a lever while it is being disarticulated.

2d. To exsect the tibia, make a longitudinal incision from three to four inches in length, along the inner margin of the bone, commencing over the internal malleolus, and carry it down to the bone. From the lower part of this incision, make a transverse section of the skin as far forwards as the tendon of the *tibialus anticus.* Dissect up the flap, and isolate the bone from the extensor tendons and anterior tibial vessels, pass a slip of wood beneath it to protect the soft parts, and complete its division with a small straight bladed saw. The chain saw can also be used to divide the bone without endangering the tendons. The tibia being sawn through, it is disarticulated in the same way as the fibula.

3d. *Extraction of the entire fibula.*—The central portion of the bone should be first denuded and cut through with the chain saw. The superior and inferior extremities are then successively extracted. If necessary, any part of this bone may be removed without opening either of its articulations.

§ 4. *Exsection of the knee joint.*—(Fig. 3.)—*Syme's method.*—1st. Flex the leg at a right angle with the thigh; make a curved incision above the patella with its convexity upwards from one lateral ligament to the other, and carry it directly into the joint; a second curved incision should then be made below the patella, with its convexity downwards, and its extremities should join the angles of the first. An elliptical flap is thus formed which removes the patella. The lateral and posterior ligaments are then to be divided, and carefully avoiding the popliteal vessels, separate the femur and tibia from the soft parts which surround them. Draw aside the soft parts with a split retractor, place a slip of wood or metal beneath the ends of the bones, and remove them with the saw. *Moreau's method* for exsecting the knee joint is analogous to that for the elbow. Two lateral incisions are carried so far up on the thigh as the point where the bone is to be divided. A transverse section below the patella unites them. The patella is extirpated while dissecting up the quadrilateral flap. The osseous extremities can then be easily exposed and exsected.

§ 5. *Exsection of the hip joint.*—*Velpeau's method.*—Make a curvilinear incision extending from the anterior superior spinous process of the ilium to the tuberosity of the ischium, which will form a large flap with its convexity downwards. Raise up the flap, divide the posterior half of the articular capsule, adduct and flex the thigh, cut the round ligament, carry the knife between the head of the femur and the acetabulum, and divide the remainder of the capsular ligament. The head of the femur is then forced out and sawn off.

Sedillot's method.—(Fig. 4.)—Make a semi-lunar flap, with its convexity upwards, which will circumscribe the great trochanter and open the articulation; the head of the bone is then forced out, and with a chain saw the operation is completed.

Plate XXXIV.

EXSECTION OF THE SUPERIOR AND INFERIOR MAXILLARY BONES.

Fig. 1. *Removal of half of the lower jaw at the articulation.—Lisfranc's method.—a, b, c,* superior quadrilateral flap turned up; *d,* the inferior maxillary bone sawn through at the chin; *e,* half of the lower jaw luxated outwards; *f,* the internal maxillary artery; *g,* the submaxillary gland.

Fig. 2. *Exsection of the middle portion of the lower jaw.—Dupuytren's method.—a* and *b,* flaps turned outwards after a vertical incision through the median line of the lower lip; the surgeon standing behind the patient is sawing through the bone, *d,* with a Hey's saw, *c.*

Fig. 3. *Removal of the superior maxillary bone.—Velpeau's method.—a, b, c,* superior flap turned upwards; the superior maxillary bone, *d,* having been detached with the assistance of a chisel and mallet, the surgeon holding a bistoury, *e,* is dividing the soft parts which still adhere to it.

Fig. 4. *Appearance of the parts after the last operation.—a a a a,* points of twisted suture.

METHODS OF OPERATING.

§ 1. *Exsection and complete extirpation of the superior maxillary bone.—Gensoul's method, modified by Velpeau.*—The patient being seated upon a low chair, with his head thrown backwards and supported upon the breast of an assistant, make an incision with its convexity downwards, from the commissure of the lips to the temporal fossa. Dissect this large flap from below upwards, and turn it back upon the forehead. The maxillary bone being thus exposed, separate one after another its connections with the other bones of the face. 1st, cut through with the cutting forceps the external orbitar process at its junction with the malar bone, the zygomatic arch, the os unguis, and the ascending nasal process of the upper jaw; 2d, divide the soft parts

Pl. 34.

Fig. 1.

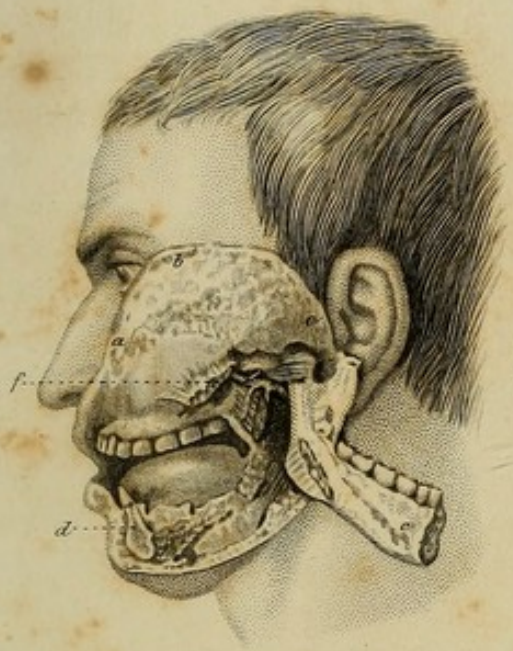


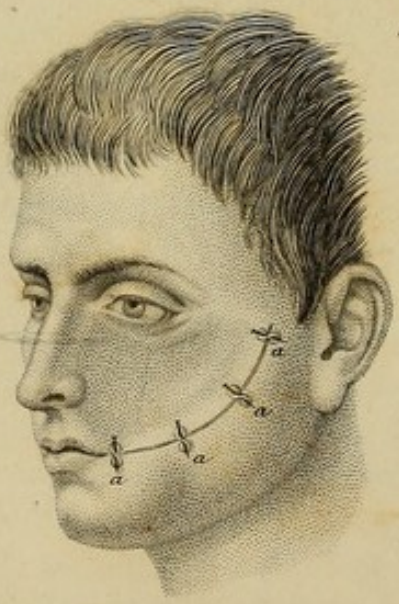
Fig. 2.



Fig. 3.



Fig. 4.



which connect the ala of the nose to the maxillary bone, and separate the two maxillæ in front with a chisel and mallet, or a small saw. Detach the soft parts from the floor of the orbit, and with flat cutting forceps, carried from above downwards, and from before backwards on the floor of the orbit, divide at once the superior maxillary nerve, and the connections of the bone with the pterygoid process. Conclude the operation by cutting through with the bistoury, or curved scissors, the velum of the palate, and the remaining soft parts which still adhere to and retain the bone.

§ 2. *Exsection and removal of the lower jaw.*—1st, *Removal of the central portion of the bone.—Dupuytren's, or the ordinary method* (fig. 2).—Seat the patient in a slightly elevated chair, with his feet raised so that they will have no purchase on the floor.* An assistant standing behind the patient holds his head firmly against his breast, and compresses at the same time the two facial arteries at the point where they cross the lower jaw. The surgeon, standing in front, seizes with his left hand one of the angles of the lower lip, while an assistant holds the other angle from the bone, and the whole in a state of tension. With a vertical incision he divides the lip through the median line at once to the bone, and afterwards prolongs it through the skin and subcutaneous cellular tissue down to the os hyoides. Keeping as close as possible to the bone, he then dissects back the two flaps, and the bone being sufficiently denuded, incises the periosteum and extracts a tooth opposite to each point where it is to be sawn through. When dividing the bone, Dupuytren stood behind the patient and used a small Hey's saw; if the chain saw is used, the surgeon stands in front of the patient. The bone being sawn through on both sides, an assistant pushes back the tongue with a spatula, to protect it from the knife, and the surgeon holding the bone with his left hand, with a probe pointed bistoury, held perpendicularly, divides the muscles attached to it, as closely as possible to their insertion, carrying the knife along its concave surface. After the division of its attachments, the tongue will

* In all the operations about the mouth and jaws, the employment of anæsthetic agents, if adopted by the surgeon, will render it necessary for the patient to be placed in a different position from those indicated above. A patient under the full influence of chloroform or ether cannot with propriety, even if it were possible, be supported in a sitting posture. He should be placed upon his back on a table of proper dimensions, with the head and shoulders so far elevated that the blood can be made from time to time to flow from the wound, otherwise there would be danger of suffocation from its accumulation in the mouth and throat.—Eds.

sometimes fall backwards, threatening suffocation. This is to be remedied by holding the head forward, when the tongue will naturally fall into the same position.*

2. *Exsection and disarticulation of one-half of the lower jaw.*—1st. Make a horizontal incision along the inferior border of the bone, extending from the symphysis to the angle of the jaw; make a vertical section at each extremity of this incision; the internal, dividing the lower lip through the median line; the external, carried from the zygomatic arch behind the ramus of the jaw. This makes a quadrilateral flap, which is to be dissected and turned up. Saw through the jaw at the median line, and keeping close to the bone, detach with the bistoury all the soft parts adhering to its posterior surface as far as the angle of the jaw. Carry a probe pointed bistoury beneath the zygomatic arch and behind the coronoid process, and with it divide the tendon of the temporal muscle while depressing the bone to disengage the process and luxate the condyle. Pull the bone strongly outwards, as far as possible from the vessels, in order to avoid especially the internal maxillary artery, and complete the operation by dividing the pterygoid muscles and the articular ligaments.

The whole, or only a part, of the horizontal portion of the lower jaw may be removed, according to the exigencies of the case.

Walther, of Bonn, has even successfully removed the whole of the lower jaw.†

EXSECTION OF THE BONES OF THE TRUNK.

§ 1. *Exsection of the ribs.*—The patient lying down in a convenient position, an incision is made appropriate to the extent of the disease in the bone. The pleura should now be carefully separated from the inner face of the rib with the point of a director, and a protecting compress passed beneath it, and the bone sawn through with Hey's saw, or divided with the bone nippers. The divided end of the rib is then raised with a blunt hook, and the intercostal muscles are cut close to the bone to avoid wounding the intercostal artery and the pleura.

§ 2. *Exsection of the sternum.*—No fixed rules can be given for this operation, on account of the variety of pathological conditions

* Or still better, seize the extremity of the tongue with a firm pair of hooked forceps, and draw it forcibly forwards.

† This formidable operation has also been recently performed, with success, by Prof. Carnochan, of this city.—Eds.

which may require it. Trephining is usually combined with exsection. It is essential to avoid injuring the mammary vessels along the sides, and the pleura beneath the bone.

§ 3. *Exsection of the spinous processes of the vertebræ, and of the bones of the pelvis.*—For the exsection of the spinous processes, an incision should be made sufficient in extent to expose the vertebræ and the muscles lying in the grooves external to the transverse processes; the bone being denuded, the diseased portion is removed with Hey's saw.*

Portions of the bones of the pelvis may be removed; the surgeon must choose his method of operating, according to the nature of the case.

* An interesting case in which this operation was successfully performed by Dr. D. L. Rogers for the removal of the spinous process of the first lumbar vertebra, depressed upon the spinal cord, and causing paraplegia, is to be found in his "Surgical Essays and Cases," p. 45.—Eds.

Plate XXXV.

TREPANNING OF THE BONES OF THE CRANIUM.

SURGICAL ANATOMY.

Fig. 1. *Vertical section of the cranium.*—The corresponding cerebral hemisphere is here shown covered by its membranes, to exhibit the ramifications of the middle meningeal artery, and the sinuses of the dura mater.

a a a, branches of the middle meningeal artery.—This artery enters the cranium through the foramen spinosum of the sphenoid bone. The anterior branch, which is the largest, winds along through the groove in the anterior inferior angle of the parietal bone. Occasionally this groove is a complete bony canal an inch or two in length. The posterior branch winds along the squamous portion of the temporal bone. Laceration of the middle meningeal artery usually takes place at the anterior inferior angle of the parietal bone.

b b b, dotted course of the superior longitudinal sinus.—This sinus is lodged between the two cerebral hemispheres, and is formed by a duplicature of the falx cerebri, whose course it follows; its posterior fifth is received into a bony groove. It commences at the *crista galli* of the ethmoid bone, and terminates at the internal occipital protuberance, *c*, at which point is situated the *torcular Herophili.*

d, the right lateral sinus.—The lateral sinuses are partly received in the grooves which separate the superior and inferior occipital fossæ. They commence at the internal protuberance, *c*, and pass along horizontally towards the base of the petrous portion of the temporal bone. They run superficially for an inch and a half or two inches, after which they turn inwards and downwards and pass through the posterior *foramen lacerum.*

Fig. 2. *Application of the trephine.—a a a a*, four flaps formed by a crucial incision of the integuments; *b*, the trephine in operation.

Fig. 3. *Exsection with cutting forceps, a*, of the bony angles left between the circular openings.

Fig. 4. *The surgeon, with a lenticular knife, a*, is smoothing the edges of the opening in the bone.

Pl. 35.

Fig. 1.

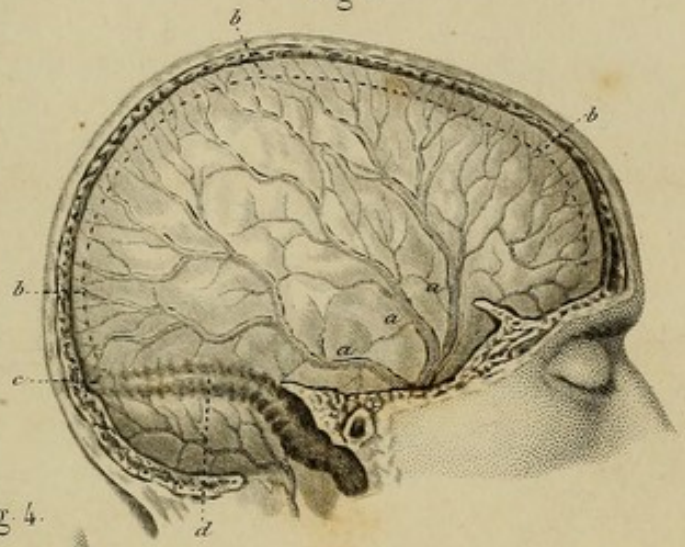


Fig. 4.

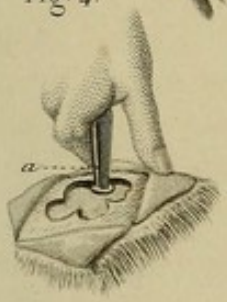


Fig. 3.

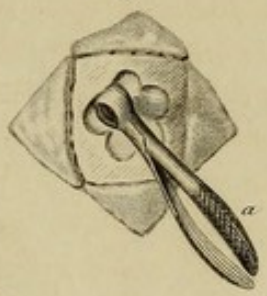
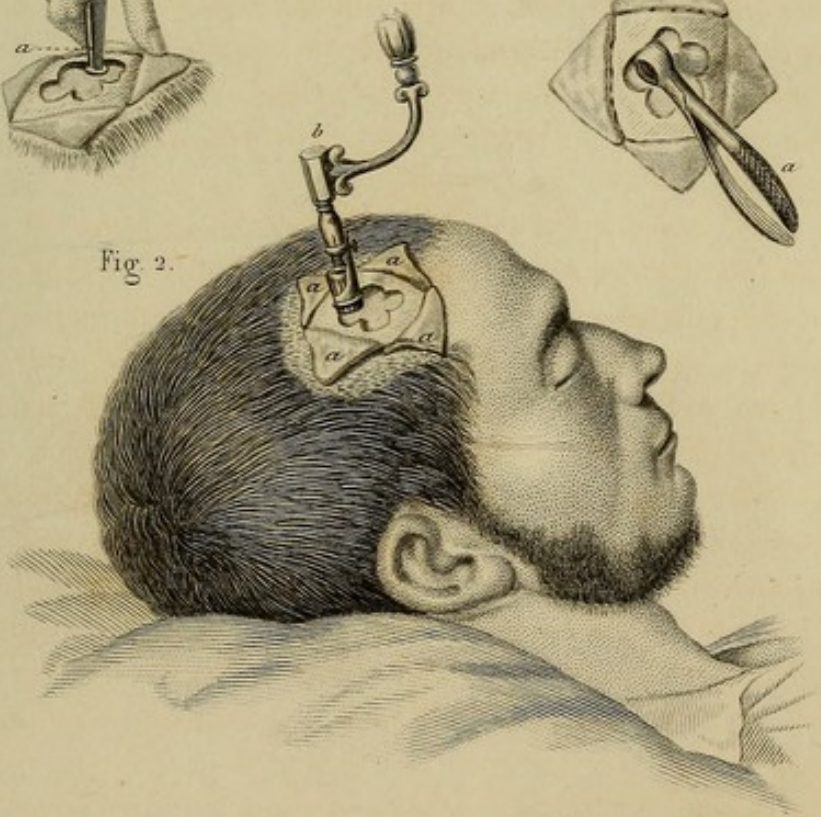


Fig. 2.



MODE OF OPERATING.

The patient should be placed in a horizontal position, with his head resting upon a board covered with a pillow, and firmly held in this position by assistants. The surgeon should then make a crucial, a V, or a T shaped incision through the integuments, and the flaps are dissected up and held aside. The periosteum is then rasped up, previous to applying the centre-bit or French trepan, or better still the English trephine. If the trepan is used, its crown and perforator must be first attached; then holding it in the right hand like a pen, the point of the perforator is placed upon the denuded bone, the ebony knob on the top of the trepan is held between the thumb and forefinger of the left hand, and the chin pressed firmly upon it, while with the right hand the handle of the instrument is turned from right to left. The perforator having entered the bone, the teeth of the crown soon make a circular groove. When this is sufficiently deep to support the crown, the perforator is removed, and replaced by the screw elevator. The movements of rotation are continued, the instrument being occasionally withdrawn to clean its teeth with the brush, and sound with the style if it acts equally upon all parts of the circle, or if the bone is already sawn through in some places. When this is found to be divided throughout its whole circumference, loosen the osseous disc, and raise it with the elevator. When the operation is concluded, if the section is not smooth, the projecting points should be removed with the lenticular knife.

With the trephine, the operation is more simple. The instrument is first applied, with its perforator projected, to the denuded bone, and it is rotated from right to left, and from left to right, with the proper degree of pressure, until a channel is traced by the teeth of the crown. The perforator should then be withdrawn, and following the same rules as given above, the operation is continued until the bone is sawn through.

When it is necessary to apply the trephine several times, the sections of the bone may be made at certain distances from each other, and the bony intervals divided through with Hey's saw. If the sections cut into one another, the bony angles which remain may be removed by cutting nippers.

If the operation of trepanning is performed for depressed bone alone, the elevator should be slipped between the cranium and dura mater, without injury to the latter. A longitudinal or crucial incision with the point of the bistoury should be made, if there is any liquid which requires exit from beneath the dura mater.

OPERATIONS UPON THE EYE AND ITS APPENDAGES.

OPERATIONS UPON THE EYELIDS.

SURGICAL ANATOMY.

Eyelids.—The structure of the eyelids presents to us the following elements for consideration:

1st. *The skin*, fine, soft, elastic and loosely attached to the subjacent tissues;

2d. *A layer of lamellated cellular tissue*, uniting the skin to the muscular layer. This tissue, very loosely connected, is from the nature of its structure favorable to the development of encysted tumors; it is frequently the seat of serous infiltrations and erysipelatous inflammations, which are occasioned by traumatic lesions of the eyelids or the face;

3d. *The muscular layer*, composed of concentric fibres of the *orbicularis* muscle, which form pale and thin arches upon each lid, and are only united at the external commissure. The upper eyelid has a muscle peculiar to itself, situated behind the orbicularis, called the *levator palpebræ*. This muscle arising from the most internal portion of the orbit, is attached by an aponeurotic membrane to the tarsal cartilage. It receives nervous filaments from the *motores oculorum*, or third pair of nerves, and its office is to elevate the upper lid, the movements of depression of the lower lid depending upon the facial nerve. Blepharoptosis usually depends upon the paralysis of this muscle.

4th. *The tarsal cartilages*, situated beneath the muscular layer, are composed of thin fibrous lamellæ which give support to the eyelids, and prevent their wrinkling or folding vertically. The cartilage of the upper lid is about double the width of that of the lower. These cartilages are united internally and externally by a palpebral ligament, given off by the orbitar aponeurosis.

5th. *The Meibomian glands* are situated between the tarsal cartilages and the conjunctiva, and open by minute foramina upon the

edges of the lids. When hypertrophied, they form the small tumors which are frequently observed on the conjunctiva.

6th. *The conjunctiva* is a mucous membrane which covers the inner surface of the lids, and is reflected over the globe of the eye. It is very vascular, particularly where it is folded upon the eyeball.

All the anatomical elements entering into the composition of the eyelids are intimately united at their free borders; but in proportion as we leave their edges, they are much more loosely connected.

The arteries which supply the eyelids are found at some distance from their free borders, lying beyond the tarsal cartilages. A semi-lunar flap can therefore be removed from their edges, without causing much hæmorrhage.

Plate XXXVI.

OPERATIONS UPON THE EYELIDS.

Fig. 1. *Symblepharon.—Von Ammon's method.*—The portion of the eyelid adhering to the globe is included between the two incisions *a b*, and *c b*, which separate it from the rest of the lid.

Fig. 2. The same operation terminated. The edges of the incision united by three points of twisted suture, while the little triangular flap, *a*, still adheres to the globe.

Fig. 3. *Epicanthus.—a b c d*, an elliptical wound caused by the removal of a fold from the skin at the root of the nose.

Fig. 4. *Blepharoptosis.—Ordinary method.—a*, self closing forceps holding a fold of the skin, *b*, of the upper lid; *c*, scissors excising the fold.

Fig. 5. *The same operation.—Hunt's method.—a b c*, position and appearance of the wound, after the removal of the flap.

Fig. 5 *bis*. The operation terminated. The edges of the wound united by points of twisted suture.

Fig. 6. *Entropium.—Janson's method.*—The surgeon seizes, with Adams' forceps, *a*, a vertical fold of skin and excises it with the flat curved scissors, *b c d*, the same operation after its performance at the outer angle of the eye; the edges of the wound united by three points of twisted suture.

Fig. 7. *Entropium.—Crampton's method modified by Guthrie.—a* and *b*, vertical incisions through the entire thickness of the lid; *c d*, transverse incision half through the lid. The edges of this incision are brought together by points of suture, *e e e e;* an adhesive strap, *ff*, fastens the threads to the eyebrow.

Fig. 8. *Ectropium.—Adams' method.—a*, the first incision through the lower lid; the surgeon seizes the edge of the lid with the forceps, *b*, and with the scissors, *c*, excises a small triangular flap.

Fig. 9. *The same operation.—Dieffenbach's method.—a b*, an incision in the lower lid; the surgeon with the forceps, *c*, draws out a fold of the conjunctiva, and excises it with the scissors, *b*.

Pl. 36.

Fig. 1.



Fig. 2.

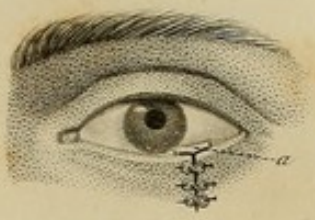


Fig. 3.



Fig. 4.

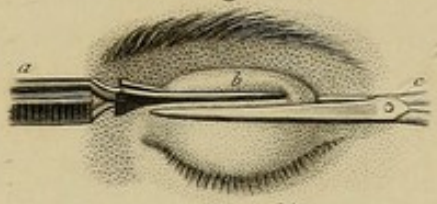


Fig. 5.



Fig. 5 bis

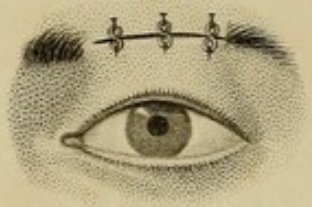


Fig. 6.

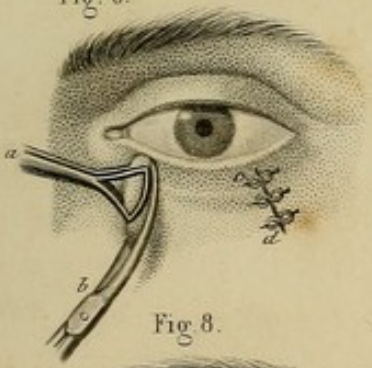


Fig. 7.

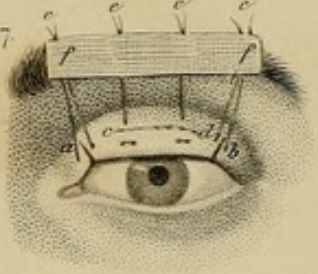


Fig. 8.

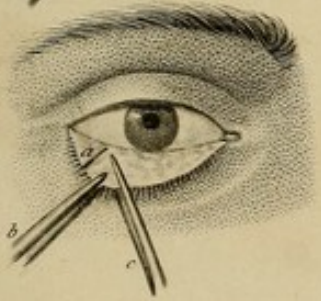


Fig. 9.



Pl. 37.

Fig. 1.



Fig. 2.



Fig. 3.

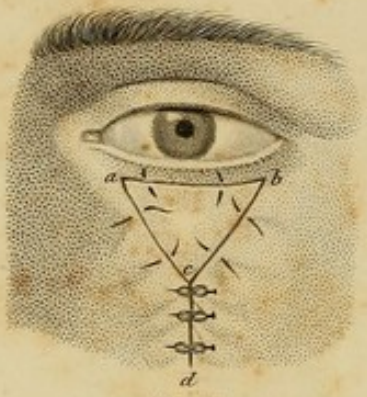


Fig. 4.

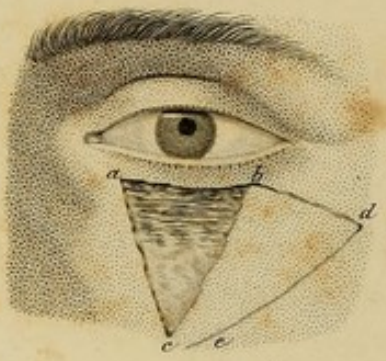


Fig. 5.

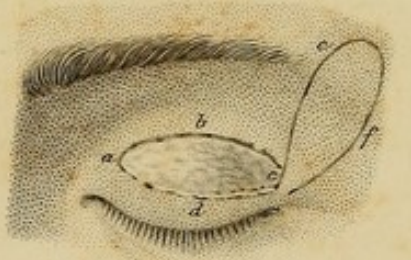


Fig. 6.

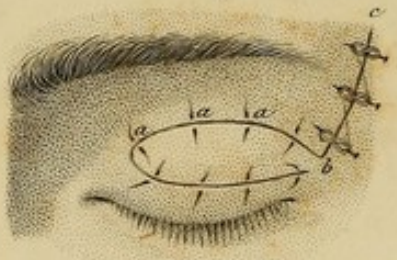


Fig. 7.

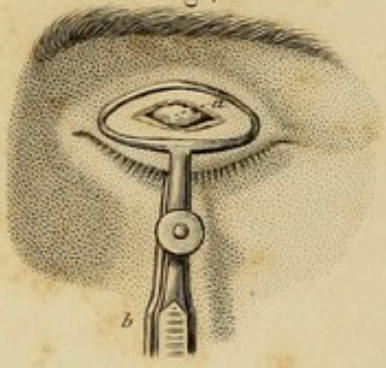


Fig. 8.

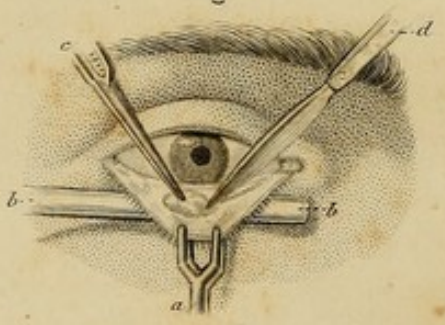


Plate XXXVII.

OPERATIONS UPON THE EYELIDS CONTINUED.

Fig. 1. *Ectropium.—Desmarres' method.—a b*, first incision commencing at the external angle of the eye; *b c*, second incision commencing at the free edge of the lower lid and joining the first at *b*; *c d* and *a d*, two incisions commencing at the internal extremities of the two first, and uniting at *d*, at the fold of the ocular and palpebral conjunctivæ.

Fig. 2. *The same operation concluded.*—The edges of the wound united by three points of suture, *a a a*.

Fig. 3. *Blepharoplasty.—Jones' method.—Operation concluded.—a b c*, a triangular flap drawn up to cover the denuded surface; *c d*, the integuments brought together to cover the wound caused by the displacement of the flap.

Fig. 4. *Blepharoplasty.—Dieffenbach's method.—a b c*, a triangular wound caused by the removal of a tumour; *b d* and *d e*, two incisions circumscribing the cutaneous flap which is to be drawn inwards to cover the wound, *a b c*.

Fig. 5. *Blepharoplasty by torsion.—a b c d*, an elliptical wound of the upper lid; *c e f*, an incision around the frontal cutaneous flap intended to cover the wound, *a b c d*.

Fig. 6. *The same operation concluded.*—The flap covers the wound; points of suture, *a a a*, fasten it to the eyelid, and the edges of the wound above, *b c*, are united by points of twisted suture.

Fig. 7. *Extirpation of tumours of the upper lid.*—The method of applying Desmarres' forceps (see Instruments, plate 8, fig. 2).

Fig. 8. *Extirpation of a tumour from the inner surface of the lower lid.*—An assistant, with a pair of double jawed forceps, *a*, everts the lower lid over a small rod, *b b*, while the surgeon with the forceps, *c*, and the small bistoury, *d*, removes the tumour.

COLOBOMA.

Colol oma is a congenital, or an accidental division of the eyelid. If the cleft is congenital, the edges are cut away and brought together by two or three points of twisted suture. If the division is accidental and recent, the bleeding edges of the wound should be united in the same manner. The first pin should be placed through the free edge of the lid, and this as well as the others should be passed through the skin and tarsal cartilage alone, and not through the whole thickness of the lid, to avoid causing the inflammation which their contact with the globe would produce.

ANKYLOBLEPHARON.

Ankyloblepharon, or the adhesion of the edges of the lids to each other, is rarely congenital; it is frequently occasioned by ulcerations of the tarsal margins, and may be complete or partial. If it is partial, the adhesion may be divided with probe-pointed scissors, or by a bistoury carried along the groove of a director introduced between the eyeball and the lids. If the adhesion is complete, a small opening should be made at the external angle of the eye between the lids, and through this, a director being introduced, a bistoury passed along its groove divides the adhesions.

Before performing this operation, the surgeon should first assure himself that there is no adhesion between the lids and the globe. If there should be any fibrous bands uniting the palpebral conjunctiva to the ball, they can usually be destroyed with the director. The operation being concluded, it is necessary to prevent new adhesions. For this purpose, astringent lotions, foreign substances placed between the edges of the lids, their forced separation by means of adhesive plaster, and cauterisation with the nitrate of silver, have all been employed. If adhesions form in spite of these means, Amussat recommends their daily destruction by a probe. Von Ammon proposes to dissect up a flap from the conjunctiva and apply it over the wound.

SYMBLEPHARON.

Symblepharon, or adhesion of the eyelids to the eyeball, is very rarely congenital, but frequently results as a consequence of inflammations of the palebral, or ocular conjunction. This affection consists of adhe-

sions caused by filaments of fibrous tissue more or less numerous, which unite the conjunctiva of the lids to the globe of the eye; they cause immobility of the organ, and require division. If they are few and isolated, they may be cut through with probe pointed scissors, curved on their flat surface. To prevent the formation of new adhesions of the cut surfaces, the eyelids should be drawn outwards with strips of adhesive plaster, so as to prevent the contact of the cut surfaces. When the fibrous bands are numerous and close together, rendering the eyeball immoveable, the following operation should be performed :—

Von Ammon's method.—(Pl. 36, fig. 1 and 2.)—Two incisions, *c b*, and *a b*, carried through the eyelid, should be made to circumscribe all that portion of the lid which adheres to the globe of the eye. The triangular flap thus isolated, accompanies the eye in all its movements. The lips of the wound in the lid must now be brought together by two or three points of twisted suture. This union is made in front of the triangular flap *a*, (fig. 2,) which still remains adherent to the eyeball. When the cicatrisation of the little wound in the lid is perfected, the triangular flap *a* is dissected off, the relapse which would have resulted from the contact of the two bleeding surfaces being no longer to be feared.

Dieffenbach's method.—To arrive at the same result, Dieffenbach produces an artificial entropium. A quadrilateral flap is formed by making two vertical incisions, one at each angle of the affected lid. The eyelashes are cut off, and the adhesions being destroyed, the quadrilateral flap is turned inwards, so that the external aspect of the lid is in contact with the wound of the eyeball, and cannot contract any adhesion with it. The wound of the ball having cicatrised, the eyelid is brought back to its natural position, and heals in its turn, without danger of adhesions forming between it and the eye.

EPICANTHUS.

Von Ammon gives the name of *epicanthus* to a crescentic fold of skin with its concavity external, which covers more or less the inner angle of the eye, (see pl. 36, fig. 3.) To remedy this deformity, a vertical fold of the skin of the nose, on a level with the epicanthus, is seized with the forceps, and cut off at once with scissors curved on their flat surface. The formation of this fold uncovers the inner angle of the eye, by drawing inwards the epicanthus which masks it. The result is an oval

wound, whose edges being brought together by sutures, causes the disappearance of the epicanthus. If the deformity affects both eyes, it may be remedied by a single operation. A fold of the skin on the dorsum of the nose, between the eyes, is cut out, and the edges brought together as above.

BLEPHAROPTOSIS.

(*Plate* 36, *fig.* 4, 5, *and* 5 *bis.*)

Falling of the upper lid has been named *Blepharoptosis*, *Ptosis*, and *Blepharoplegia*. It may be produced by a redundancy of the integuments, or by partial or complete paralysis of the *levator palpebræ superioris*. The surgical treatment of this affection consists in removing the superfluous position of the lid, thus equalising its extent with its functions.

Ordinary method (fig. 4).—Seize with the self closing forceps *a*, a transverse fold of the skin *b*, of the upper lid. It is essential that the fold of skin removed should be of such size that the patient may be enabled to close the eye after the operation; if the fold is too small, a second operation will be required; if too large, ectropium may be the result. The skin should be excised with a single cut of the scissors *c*. The result is an elliptical wound, whose edges should be brought together by two or three points of suture. Some surgeons introduce the threads into the fold of skin held by the forceps and afterwards excise it in front of them, by this means having the sutures ready placed in the edges of the wound. The adoption of this practice abridges the operation, and renders it less painful.

Hunt's method (fig. 5 and 5 *bis*).—After shaving the eyebrow, a semi-elliptical flap, *a b c*, is removed from it. The extent of the flap should depend upon the degree of the relaxation of the lid; the edges of the wound which results from its removal are to be brought together as above. By this means the upper lid is drawn up (see fig. 5 bis). In this operation the inferior fibres of the occipito-frontalis muscle are exposed, and the upper lip is attached to them. The cicatrix of the wound is concealed by the eyebrow. Sedillot proposes to make use of the *corrugator supercilii* by dividing its external insertion, and bringing it down upon the lid. By this method, the movements of the eyelid depend upon those of the corrugator muscle.

ENTROPIUM.

Entropium is the affection caused by inversion of the eyelids. The surgical treatment of this disease should depend upon the nature of the causes which produce it. Among these may be enumerated, diseased condition of the skin or of the mucous membrane lining the eyelids, contraction of the *orbicularis* muscle, alterations of the tarsal cartilage, &c. Entropium produced by relaxation of the skin, or spasmodic contractions of the *orbicularis*, may be successfully treated by astringent or antispasmodic lotions; adhesive straps holding the diseased lid temporarily everted, willl often suffice to cure senile entropium. If these means should prove ineffectual, recourse may be had to blisters (Carron du Villards), or *cauterisation*, which will result in cicatrices, the contraction of which will produce an eversion of the lid. The blister should take the shape of the lids, and be kept open for several days. A visible cicatrix is the result. *Cauterisation* is effected with a red hot iron, or with sulphuric acid. In using the red hot iron, a Beer's spatula should first be introduced beneath the lid to support it and protect the globe of the eye; a small cautery iron heated to a white heat is then rapidly carried across the integument of the eyelid so as to leave a transverse eschar. Cauterisation with sulphuric acid, as proposed by Quadri, is less painful. After determining the position and extent of the eschar to be produced, the eyeball is protected by means of a strip of adhesive plaster applied over the fissure of the lids; a small quantity of sulphuric acid is then rubbed transversely over the lid with a glass rod, or a pencil of asbestos. After the acid has remained some ten or fifteen seconds, it should be wiped off. If the disease is not cured by the first cauterisation, it may be several times repeated, until the lid has resumed its natural position. It sometimes happens, that the operation is carried a little too far, causing eversion to succeed inversion. This is remedied by attaching a thread to the eyelashes and fastening it upon the cheek for the upper, upon the forehead for the lower lid.

Excision of the skin, proposed by Celsus.—This is performed in the worst cases of entropium; a transverse fold of skin is excised, whose size is proportioned to the extent of the inversion. The methods described for the operation for blepharoptosis (*see* pl. 36, fig. 4, 5, and 5 *bis*)—are also applicable to entropium.

Janson's method (see pl. 36, fig. 6).—Instead of a transverse, a vertical fold is seized with Adams's forceps *a*, and excised with the curved scissors *b*. The edges of the wound are united either by threads passed through the fold of skin before its excision, or by points of twisted suture *c d*. It is sometimes necessary to excise two or three folds, one not sufficing.

Crampton's method modified by Guthrie (see pl. 36, fig. 7).—Usually performed in cases of entropium, dependent upon a diseased or defective condition of the tarsal cartilage. The surgeon, with straight scissors, makes a vertical incision, *a*, through the entire thickness of the lid, a little external to the punctum. A similar incision, *b*, is made near the external angle; the flap between the two incisions is then turned up, and they are united by a transverse section through the mucous membrane only. The flap is then allowed to fall back, and a transverse fold of skin, *c d*, is cut from the integuments, the threads, *e e e e*, serve to unite the lips of the wound, and are fastened upon the forehead with the adhesive strap, *ff*. This painful and difficult operation causes a permanent deformity of the lid, and is now rarely employed.

Saunders' method consists in the removal of the tarsal cartilage. After introducing a Beer's spatula beneath the lid, an incision is made extending from one angle to the other, parallel to the edges of the lids, and one or two lines from the roots of the eyelashes; the skin is then dissected up to the orbitar edge of the tarsal cartilage, which is seized with the forceps, detached from the conjunctiva, and removed.

TRICHIASIS.

Trichiasis, or inversion of the eyelashes upon the mucous membrane of the globe, differs from entropium, in the fact that in the former the tarsal cartilage retains its natural position.

The disease depends either upon an unnatural direction of the eyelashes, or upon an abnormal seat of growth. There are in the latter case sometimes two rows of ciliæ (*distichiasis*), or even three (*tristichiasis*).

Trichiasis is *complete* when all the ciliæ are inverted; *partial*, when a few only have this unnatural tendency. The same operations which have been already described for entropium, proportioning them to the gravity of the disease, may be performed for complete trichiasis, which depends upon simple inversion of the lashes alone. In partial trichia-

sis, Desmarres seizes with a double strabismus hook, a small transverse fold of skin, near the edge of the lid where the eyelashes are inverted, and excises it with a cataract knife; the result is a small wound, which in healing, draws back the ciliæ to their normal position.

The ciliæ may be made to turn outwards and resume their natural direction of growth, by everting and fastening them to the integument of the lid by means of adhesive plaster, or by the skilful application of collodion. Teaching the patient to employ the finger, previously moistened in the mouth, to turn the eyelashes outwards frequently during the day, will also answer the same purpose. These methods of cure are only applicable in cases of partial trichiasis.

Extraction may be performed alone, or united with *cauterisation.* Each lash must be extracted by itself with depilatory forceps. The operation requires to be frequently repeated, and to prevent the hairs from growing again, cauterisation has been connected with it. Champmesme uses a small cautery iron terminated by a ball, from which a fine needle projects. The ball is heated to a white heat, and the point of the needle introduced into each bulb. The operation is tedious, painful and difficult. Carron du Villars introduces a long pin into each bulb; the pins then united in a bundle, and grasped between the jaws of a pair of curling tongs heated to a white heat. The heat is instantly communicated to the pins, and all the bulbs are cauterised at the same time.

In *extirpating* the bulbs, as proposed by Vacca Berlinghieri, an ivory spatula is introduced beneath the eyelid, and an incision made parallel to its edge, and carried as far as the disease extends. Two small incisions are made at right angles with, and at the extremities of the first; the small cutaneous flap thus formed is then raised and the bulbs exposed, which one by one are dissected out. Petrequin, of Lyons, removes the cutaneous flap entirely, and the cicatrisation of the wound produces a favorable eversion of the border of the lid.

Excision of the edge of the lid is performed with scissors, care being taken not to injure the puncture. In partial trichiasis, Schreger excises a V shaped flap, the same as in Adams' operation for ectropium.

ECTROPIUM.

(*Plate* 36, *fig.* 8 *and* 9, *and Plate* 37, *fig.* 1 *and* 2.)

Ectropium, or eversion of the eyelids, is frequently produced by the same causes as entropium.

Diseases of the conjunctiva, deformities of the tarsal cartilage, contraction of the skin, and the affections which give rise to it, disease of the orbicularis muscle, &c., are among the causes which produce the several varieties of ectropium, requiring different methods of treatment.

Ectropium caused by diseases of the conjunctiva.—If acute inflammation of the conjunctiva produces a temporary puffy swelling, the ectropium which results from it may usually be remedied by scarification or the application of the nitrate of silver. But should the conjunctiva become hypertrophied and covered with fungous granulations, cauterisation will be insufficient; the swelling caused by the protruding mucous membrance must be excised. The conjunctiva should be seized with the forceps, or a double hook, and the exuberant growth cut off with the curved scissors; the eyelid is then turned back, and kept in apposition with the globe by a compress and bandage.

Antyllus removed a triangular flap, with its base towards the edge of the lid, from the mucous membrane. This difficult operation offers no advantages over the former.

Dieffenbach's method.—(Pl. 36, fig. 9.)—Make a transverse incision, *a b*, upon the skin of the eyelid, beyond the tarsal cartilage, and carry it through the lid to the conjunctiva. Seize the mucous membrane with the forceps, *c*, and draw it through the wound until the eyelid is inverted. Cut off this portion of the membrane with fine scissors, and unite the lips of the wound in the conjunctiva to the inferior lip of the wound in the integuments by a few points of suture.

Adams' method (pl. 36, fig. 8).—This operation should be performed when the ectropium is caused by too great length of the lid. A triangular flap extending through the entire thickness of the lid is removed. The base of the flap should be at the border of the eyelid, and proportioned in size to the amount of relaxation. The edges of the wound are brought together by points of twisted suture, as in the operation for coloboma.

Desmarres' method (pl. 37, fig. 1 and 2).—Desmarres, to avoid the unseemly scar produced by Adams' method, performs the following operation: he makes a transverse incision, *a b*, from the external angle of the eye; a second, *c b*, is carried from the edge of the everted lid to join the first at *b*. Two others, *c d*, and *a d*, form a small triangular flap upon the conjunctiva, whose base coincides with the base of the first flap *a b c*. He then excises the tissues between these incisions, and unites the edges of the wound, *a b*, and *c b*, with points of suture, (fig.

2,) *a a a.* The cicatrix is concealed in the wrinkles at the external angle of the eye.

Ectropium caused by the elongation or malformation of the tarsus. —This may be remedied by excision of the cartilage. After removing the granulations upon the conjunctiva, Weller exsects a strip of the tarsal cartilage one or two lines in width, taking care not to injure the external border of the eyelid. The wound requires no treatment.

Under the name of *tarsoraphy*, Walther describes an operation which consists in removing the two external extremities of the tarsal cartilages in one triangular flap. The base of the flap comprises the whole of the external angle of the eye, and its summit is directed towards the temple. The lips of the wound are brought together with a few points of twisted suture.

Ectropium from contraction of the skin.—Cicatrices following burns, or wounds with loss of substance, are the most frequent causes of this variety of ectropium. In some of these cases, Adams' method may be adopted (pl. 36, fig. 8), one of the incisions being prolonged beyond the apex of the triangle formed by the union of the two.

If the cicatrices are of small extent, and have contracted no adhesions with the subjacent bones, they may be divided transversely, and cicatrisation promoted whilst the lips of the wound are kept apart by means of strips of adhesive plaster, or by the introduction of foreign bodies which will prevent immediate union. Amussat advises the daily destruction of the inodular tissue as it forms in the bottom of the wound.

If the cicatrix adheres to the borders of the orbit, it should be circumscribed by two incisions, and the lips of the wound thus formed dissected up for some distance and brought together by points of suture over the adherent cicatrix. This operation has been successfully performed by Von Ammon and Desmarres.

The operation of blepharoplasty should be performed when the cicatrices are too extensive for the employment of the methods above described. (See pl. 37, fig. 3, 4, 5 and 6.)

The *diseases of the orbicularis muscle* which produce ectropium are: spasmodic contractions, and displacement of its muscular fibres. In the first, the usual medical remedies should be employed; if they fail, the fibres of the muscle may be cut across beyond the border of the tarsal cartilage; in the second, Desmarres recommends cauterisation with sulphuric acid, or the excision of a fold of skin near the ciliary

border of the eyelids. The removal of this fold of skin tends to approximate the muscular fibres which are at too great a distance from the free border of the tarsal cartilage.

TUMOURS OF THE EYELIDS.

1st. *Encysted tumours.*—These are found upon the free borders and the surface of the eyelids, and are indolent, circumscribed, and very moveable. According to their situation, they are: 1st. subcutaneous; 2d. submuscular, lying beneath the *orbicularis* muscle, and consequently less moveable than the first; 3d. submucous, lying between the tarsal cartilage and the conjunctiva.

The surgical means employed for their removal are: *incision, cauterisation* and *excision.* They may be operated upon from the external or from the conjunctival aspect of the lids; their situation furnishes the indications of the method to employ. Their extirpation from the conjunctival aspect of the lids has the advantage that it leaves no visible cicatrix, and is less liable to be followed by erysipelas. *Incision* alone rarely suffices to prevent relapses. It is to be preferred in tumours seated between the conjunctiva and the tarsal cartilage and adhering to the latter, whose extirpation would require wounds, which in cicatrising might finally cause entropium.

Incision accompanied by cauterisation with the nitrate of silver is more effectual; it is followed by adhesive inflammation of the parietes of the cyst.

To perform the operations of incision, or excision, of these cysts through the conjunctiva, an assistant should hold the lid, either with his fingers or with a pair of double jawed blunt forceps, everted over a small rod, (see pl. 37, fig. 8); the surgeon, armed with a pair of forceps and a bistoury, then makes an incision through the conjunctiva extending a little beyond the tumour to the right and left; the cyst should then be dissected up and removed without cutting into it. In removing cysts through the integuments, the lid should be held by the fingers, and the dissection performed as described above. In all these operations, the tumour is to be isolated from the tarsal cartilage with much care.

Desmarres' method (pl. 37, fig. 7).—This method has the advantage of facilitating the operation, as the eyelid is supported, and the hemorrhage arrested by means of compression around the tumour. A pair of forceps, (see Instruments, pl. 8, fig. 2), one of whose branches is terminated by a plate, and the other by a ring, is used to hold the

lid. The instrument being closed by means of a screw, the hæmorrhage is arrested by the compression of the ring upon the parts surrounding the tumour. The forceps are held by an assistant, and the surgeon extirpates the tumour after the method which has been described above.

2d. *Chalazion* is a small indolent slightly moveable tumour situated on the free border of the lids. A series of them, having the appearance of a string of beads extending from one angle of the eye to the other, is of by no means rare occurrence. The various operations described for the removal of encysted tumours are also applicable to this affection.

3d. *Erectile tumours.*—Compression, ligature and cauterisation have all been successfully employed for their removal. The form and extent of the tumour should indicate the method to be adopted. Caron du Villars passes a number of needles through the tumour, which he afterwards attaches to a metallic ball. This ball is heated to a white heat, and the cauterisation which ensues is followed by suppuration, which destroys the tumour.

4th. *Cancerous tumours.*—No general rules can be given for their removal; they may be circumscribed by a curved, or included in a V shaped incision. The lips of the wound, when its form and extent will permit, should be brought together by points of suture.

5th. *Encanthis*, or tumour of the caruncula lachrymalis, may be treated by caustics, or extirpated. The latter is to be preferred. The tumour should be drawn upward and outward with a hook or forceps, and then excised with the bistoury or curved scissors.

BLEPHAROPLASTY.

(*Plate* 37, *Fig.* 3, 4, 5 *and* 6.)

Blepharoplasty is an operation, by which the eyelids ,which have sustained a partial or total loss of substance, are restored at the expense of the adjacent parts.

There are three methods described for attaining this end, *extension* or *sliding; displacement* (French method); and *twisting of the flap* (Indian method).

1st. *Method by extension.—Jones' operation* (pl. 37, fig. 3).—After freshly excising the margins of the opening occasioned by a loss of substance which is to be restored, two incisions, *a d*, and *b d*, are made

from its extremities, which form a V shaped flap, on the forehead for the upper, on the cheek for the lower lid, the base of this triangular flap being intended to repair the injured eyelid. This first stage of the operation being finished, the triangular flap is then to be dissected up and partly detached, commencing at its apex; by gentle traction, it is then made to advance or slide along until its base covers the opening created by the loss of substance, which it is intended to repair; it is retained in its place by points of suture, and the edges of the wound, *c d*, which the change of position of the apex of the flap has left behind it, are brought together in the same way. The figure 3 represents the operation concluded, the flap *a b c* being drawn up to cover the opening caused by the loss of substance.

2d. *Operation by displacement.—Dieffenbach's method.*—Dieffenbach having removed a triangular flap *a b c* (fig. 4), to repair the wound thus caused, makes an incision from the external angle *b*, to the point *d*, and carrying it from thence to *e*, forms the flap *c b d e*, which adheres by the pedicle *c e*. This flap being dissected up is carried over the wound *a b c*, and fastened there by points of suture; the wound which remains being of a healthy character, rapidly heals.

3d. *Method by twisting the flap.* (Graefe and Tricke), fig. 5 and 6. —The morbid cicatrices are removed by the two incisions, which form an elliptical wound, *a b c d;* a flap is then cut from the temporo-frontal region for the upper, and from the cheek for the lower lid. This flap should be made one or two lines larger and of the same shape as the wound which it is to fill. It is made by carrying an incision from the point *c*, along the line *e f*, which is to be brought back to the level of and a little external to its starting point *c;* the flap being dissected up, must then be twisted upon its pedicle and placed horizontally upon the wound, *a b c d*, where it is retained by the points of suture, *a a a*, (fig. 6); the edges of the resulting wound *c b* are then brought together by three points of twisted suture.

Fig 1

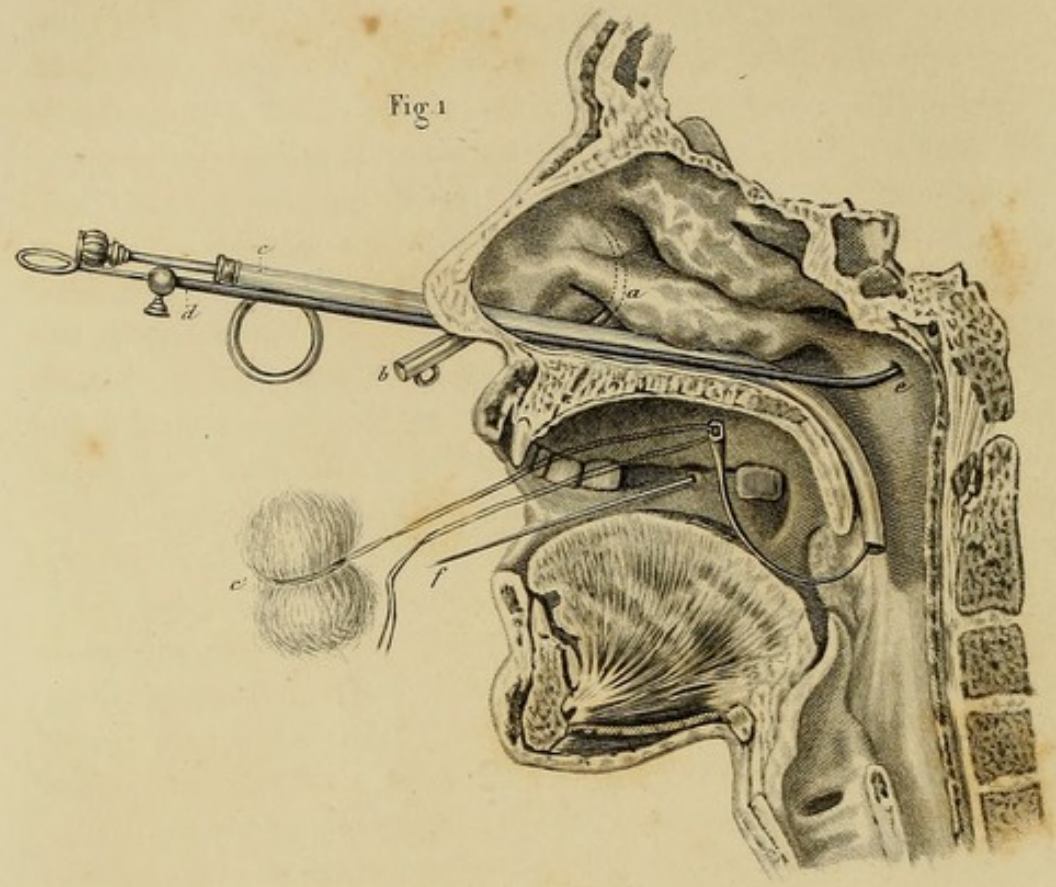


Fig. 2.

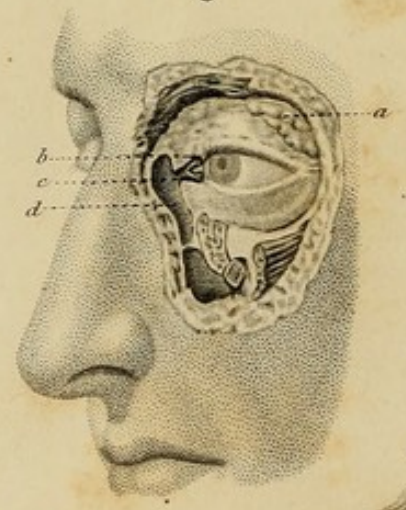


Fig 3.

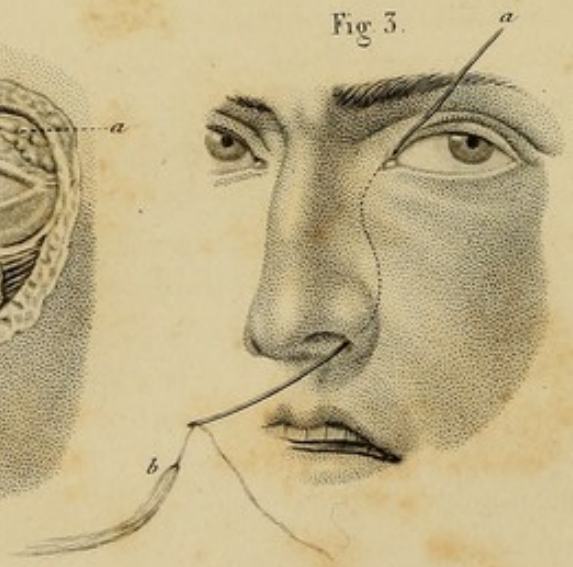


Plate XXXVIII.

OPERATIONS UPON THE LACRYMAL APPARATUS.

SURGICAL ANATOMY.

Fig. 1. *Vertical section from before backwards, showing the arrangement of the nasal fossæ, the mouth and the pharynx.*—*a*, the inferior turbinated bone; *b*, Laforest's sound introduced into the nasal duct by the inferior meatus; *c*, Belloc's sound for plugging the posterior nares; *d*, Deleau's catheter, introduced into the Eustachian tube *e; f*, probe introduced into the orifice of Steno's duct.

Fig. 2. *Anatomy of the lacrymal apparatus.*—The lacrymal gland and its excretory ducts, the puncta lacrymalia and the lacrymal canals, the lacrymal sac and the nasal duct constitute the lacrymal apparatus.

The *lacrymal gland*, *a*, is composed of two distinct portions lying close to each other. The largest, or orbitar portion, is situated in the small fossa of the arch of the orbit, to which it is closely attached by fibrous connections; its anterior border lies close to the edge of the roof of the orbit. The smaller, or palpebral portion, is situated a little lower and more external than the former; it is covered by a dense fibrous membrane and by the upper lid; its inferior margin frequently extends as far as the superior border of the tarsal cartilage.

The *puncta* are the external orifices of the lacrymal canals, *b*, and *c*. Situated upon the free border of the eyelids, a line and a half or two lines to the outside of the internal commissure, they present the appearance of narrow open channels upon the top of two small conical tubercles. The inferior looks upwards, and the superior, downwards. Their calibre allows the introduction of a hog's bristle. Among the inhabitants of the tropics, their diameter is greater, permitting the easy introduction of a small probe. According to Janin, the diameter of the inferior punctum is much greater than that of the superior, an anatomical arrangement which is taken advantage of in performing catheterism of the lacrymal passage.

The *lacrymal canals*, *b* and *c*, perforating the substance of the eyelids, conduct the tears into the lacrymal sac. The angular direction which they take should be borne in mind in performing the operation of catheterism. After leaving the puncta, they take a perpendicular direction, the superior upwards, the inferior downwards into the eyelid; after a short passage of about a line, they make a sudden curve inwards; the superior a little obliquely from above downwards, the inferior from below upwards. The lacrymal canals, thus taking a direction towards each other, open into the lacrymal sac sometimes by the same duct, but usually they are separated by a partition. Their texture is loose, and by a slight traction outwards of the edges of the lids, we can give them such a direction as will permit the introduction of straight probes. Their calibre, which is greater than that of the puncta, is always maintained uniform by the elasticity of their walls.

The *lacrymal sac*, *d*, and the nasal duct, by their union form a single canal through which the tears pass to be discharged beneath the inferior turbinated bone of the nasal fossæ. The *lacrymal sac*, which is at the upper portion of this canal, has the shape of a small oblong, vertical reservoir, into which the lacrymal ducts open. Terminated superiorly by a *cul-de-sac*, it continues inferiorly with the nasal duct. It is lodged in an osseous groove, formed within and behind by the *os unguis* and the ascending nasal process of the superior maxillary bone. Its external half is membranous, and covered by the tendon of the *orbicularis* muscle, which is overlapped above and below by the lacrymal sac. This relation it is important to recollect, as the tendon of the *orbicularis* serves as a guide when opening into the sac. However, the insertions of this tendon sometimes vary, so that surgeons have been forced to have recourse to other guides; the superior orifice of the nasal duct is situated behind the bony ridge which is met with on the inner side of the base of the orbit by passing the finger from without inwards along the inferior orbitar ridge. This osseous projection, which is the limit of the lacrymal groove below, is the most certain landmark.

The *nasal canal*, the continuation of the lacrymal sac, is formed in its osseous portion, in front by the ascending nasal process of the superior maxillary bone, within and behind, by the os unguis and the small hook-like process of the inferior turbinated bone, and outwardly, by the inner wall of the antrum. Through the posterior wall of the nasal canal, we may penetrate either the nasal fossæ or the maxillary sinus.

The length of the canal varies from four to six lines; its superior orifice is elliptical from behind forwards, and its antero-posterior diameter varies from two to three lines. The inferior orifice, situated beneath the inferior turbinated bone, is funnel shaped from within outwards and is excavated from the external parietes of the nose; in front it is provided with a small valve-like projection, which is frequently so large as to prevent the introduction of instruments except from behind forwards.

FIG. 3. *Catheterism of the lacrymal passages by the punctum in the upper lid.*—*a*, Mejan's probe; *b*, seton.

Plate XXXIX.

OPERATIONS UPON THE LACRYMAL APPARATUS, CONTINUED.

Fig. 1. *Catheterism of the lacrymal passages by the inferior opening of the nasal duct.—Laforest's method.—a*, first position of the sound; *b*, second position of the sound; its point is within the inferior orifice of the nasal duct; *c*, third position of the sound introduced into the nasal duct.

Fig. 2. *Temporary dilatation of the lacrymal passages.—J. L. Petit's method, modified by Desmarres.—a*, the finger of an assistant drawing outward the external angle of the eyelids, to render prominent the tendon of the orbicularis; the surgeon has made a puncture of the lacrymal sac with the bistoury, *b*, and inserted the probe, *c*, into the opening.

Fig. 3. *Third step of the operation.*—A grooved director, *a*, is introduced into the lacrymal canal; it serves as a guide to the catgut, *b*, with which it is intended to produce the temporary dilatation.

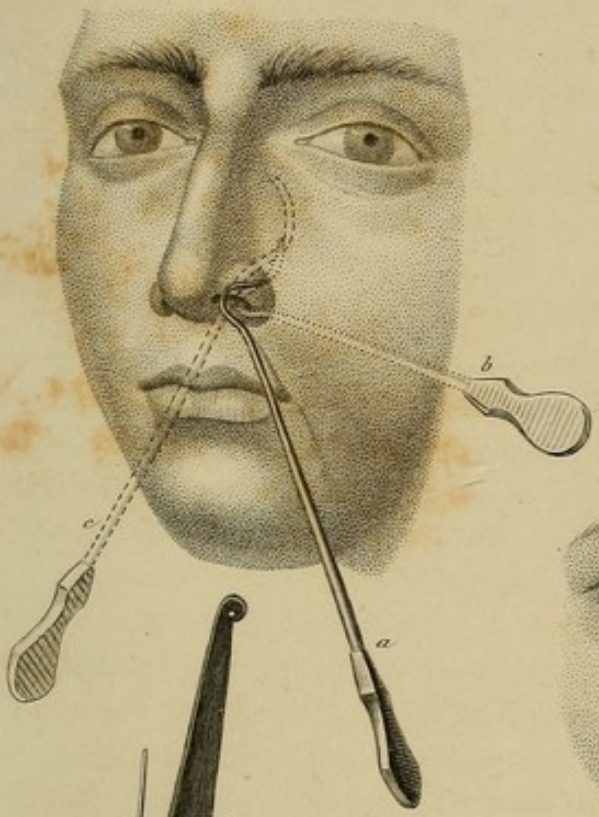
Fig. 4. *Permanent dilatation; introduction of the canula.*—The canal having been opened by the bistoury, *a*, which is pressed against the posterior lip of the wound, the surgeon is introducing the canula, *b*, by aid of the style-forceps, *c* (see Instruments, pl. VIII, fig. 5).

LACRYMAL TUMOUR AND FISTULA.

MODES OF OPERATING.

The various affections to which the lacrymal apparatus is subject, may give rise to a mechanical stoppage of the flow of the tears, or cause an accumulation of fluid in the lacrymal sac, which will distend it and produce what is called the *lacrymal tumour*. If this tumour is not properly treated, it increases in size, the skin inflames, ulcerates, and the fluid contained in the sac is discharged through this accidental opening, producing *fistula lacrymalis*. In the surgical treatment of

Fig. 1.



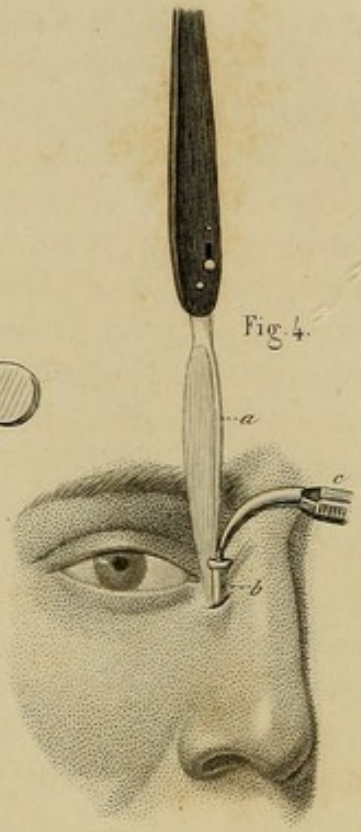


Fig. 4.



Fig. 2.

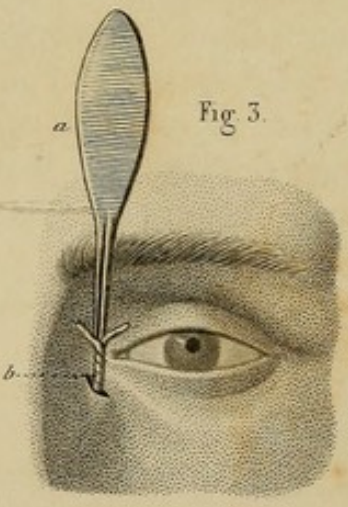


Fig. 3.

these affections, one of the three following ends is to be attained: 1st, the re-establishment of the natural passages for the tears; 2d, the formation of new passages; 3d, the obliteration of the natural passages.

§ 1. *Re-establishment of the natural passages.*—The means employed for this purpose are—injections, catheterism, dilatation and cauterisation.

1st. *Injections.*—Injections are frequently used with success for the removal of obstructions; medicated fluids can at the same time be conveyed into the interior of the lacrymal passages. Anel's syringe is usually employed (see Instruments, pl. VIII, fig. 11). The patient being seated in a chair, with his head firmly held by an assistant, the surgeon holding the instrument in his right hand, stands in front if he operates upon the left eye, and if he is not ambi-dextrous, behind the patient when he operates upon the right eye. The fingers of the hand which is disengaged slightly evert the lower lid, so as to cause the opening in its punctum to project a little; the punctum of the lower lid is preferred for the operation because it is larger and its canal shorter than that of the upper lid. The extremity of the syringe should be entered perpendicularly to the border of the lid. It occasionally happens that the punctum contracts so that the instrument cannot be introduced; this momentary spasmodic resistance is in general easily overcome by moderate and well managed pressure. The extremity of the instrument being introduced to the depth of a line or a line and a half, the syringe should then be inclined outwards so as to give the pipe the direction of the horizontal portion of the canal. Having at length entered the lacrymal sac, the surgeon forces out the liquid little by little, so as to overcome the obstructions in the duct. This being effected, the fluid will flow freely into the nostril.

2d. *Catheterism.*—Catheterism is performed with silver probes sufficiently fine to pass through the puncta. They are usually introduced through the superior lacrymal canal. A slight traction outwards of the upper lids straightens the angular direction of the canal into which the probe is to be introduced. It is then pushed into the nasal duct.

Catheterism by the inferior orifice of the nasal duct.—Laforest's method.—This is performed with either hollow or solid sounds, which should be curved in the same shape as the canal. The patient being seated with his head slightly thrown back, an assistant holds it firmly in this position; the surgeon then carries the extremity of the sound into the nostril in such a way, that by a movement of rotation given to the instrument its point will pass beneath the inferior turbinated bone

of the nasal fossæ (see pl. 39, fig. 1, *a*). This movement of rotation being performed, it is now necessary to direct the point of the sound into the inferior orifice of the nasal duct. This is effected by giving the instrument a slight movement forward and backward, for the inferior meatus is usually entered from behind forward; *b*, represents this second position of the sound. Giving the instrument a half turn, by which the handle is carried inwards and downwards (see *c*), it passes through the nasal duct and enters the lacrymal sac. Solid sounds are the best for the removal of obstructions, but the passage once free, the hollow instruments of Gensoul, by which fluids can be injected from below upwards, are to be preferred (see Instruments, pl. VIII., fig. 8).

3. *Dilatation.—Mejean's method*—This consists in performing catheterism, through the punctum of the upper lid, by means of a probe whose superior extremity has an eye, through which a thread of silk is passed. The probe is carried through the nasal duct, and brought out by the inferior meatus with the thread attached to it. To the inferior extremity of this thread, a few filaments of silk are fastened, forming a small seton, which is introduced from below upwards into the lacrymal sac, by pulling upon the superior extremity of the thread which hangs from the punctum of the upper lid. Or, the eyed probe may first be introduced and passed through the nasal duct, the thread and seton then attached to it, and all drawn through together (see pl. 38, fig. 3). By adopting the last method, the punctum runs less risk of being chafed.

4. *Dilatation by an artificial opening.*—J. L. Petit first performed the operation of opening the lacrymal sac, for the purpose of introducing into it foreign bodies for its dilatation. He made the incision with a grooved bistoury, along which he passed a bougie which was changed every day until the canal was sufficiently dilated. The external wound healed spontaneously.

Scarpa introduced leaden styles into the nasal duct (see Instruments, pl. VIII., fig. 13).

Lecat opened the sac in the same way; but instead of a bougie or other solid body, he introduced a fine catgut or eyed probe into the lacrymal passages, by means of which he drew a tent from below upward into the nasal duct. This method differs from that of Mejean only in the fact that the artificial opening facilitates the passage of the probe.

Pouteau, to avoid leaving an unseemly scar, made an opening into the sac from the internal aspect of the eyelid.

Jurine first introduced a canula, along which he passed a curved probe, which is brought out at the nostrils; to this probe a thread is attached by which the tent is drawn up.

Pamard (see Instruments, fig. 15) passed through the canula a watch spring, which from its elasticity emerges at the nostril, and to it the thread with the tent can be tied.

Fournier attached a small piece of lead to the thread, to carry it through by its weight.

Cabanis introduced under the inferior turbinated bone a perforated disk, on which the inferior extremity of Mejean's style when passed through the duct is received. A second disk, slid upon the first, seizes this extremity of the style, which is then easily drawn out.

M. Manec introduces into the nasal duct from below upward a sound with a concealed point. This instrument, when inserted, is made to pierce the anterior wall of the lacrymal sac from behind forwards; a thread is passed through an eye in the sound, which is then drawn out below, and by means of this thread a tent can be carried into the passage.

M. Morel Lavallée uses with advantage a style slightly curved in the shape of a bow; a small groove in the extremity of the instrument serves to retain a thread, which is easily seized below the turbinated bone with the forceps, and thus drawn out.

These are the principal modifications of the modes employed by J. L. Petit and Lecat for carrying a tent through the ductus ad nasum. Whatever method is adopted, the rules for opening the sac are the same.

Desmarres' method (see pl. 39, fig. 2 and 3).—The instruments required are a bistoury, a conducting probe, a groove director, and a piece of catgut.

1*st step.—Incision.*—An assistant firmly holds the head of the patient, and at the same time draws out with his finger the external angle of the eye in order to render the tendon of the orbicularis muscle more prominent, which serves as a guide for finding the superior orifice of the nasal duct (see Surgical Anatomy, p. 128). The surgeon holding the bistoury in his right hand, with the little finger resting upon the cheek for a support, plunges it into the lacrymal sac, from before backward, in the direction of the os unguis; he then carries the handle of the instrument a little inward and backward, until it touches the eyebrow, and now gently pushing the blade onward for about two-

thirds of an inch into the lacrymal sac and nasal duct, he finds that the bistoury, if it has been properly directed, will support itself. Should a fistula exist, whose opening is distinct from the point of puncture, the septum of soft parts separating them should be cut through, so that the fistulous track may be completely laid open.

2*d step.--Introduction of a probe upon which a grooved director is passed.*—The bistoury is partly withdrawn, and a probe is slid along its blade and pushed into the nasal duct (fig. 2). This probe serves as a conductor for a grooved director.

3*d step.—Introduction of a catgut* (fig. 3).—The director being in the nasal duct, a piece of catgut intended for dilatation is passed along its groove; pressing on the extremity of the catgut to retain it in its position, the director, now useless, should be slowly withdrawn. The catgut is provided with two little projections which prevent its falling into the nasal duct. It should be changed daily for another somewhat larger, and after a short time Scarpa's style may be substituted. The introduction of the catgut is frequently followed by a very severe inflammatory reaction, caused by its swelling in the interior of the duct; should this be the case, it must be removed in twenty-four hours, and a very fine Scarpa's style introduced in its stead, which is to be replaced day by day by others, gradually increasing in size.

5th. *Permanent dilatation.—Introduction of the canula.*— Vesalius first applied the canula to the treatment of lacrymal affections. This method, practised a long time after by Foubert, Wathen and Pellier, was again brought into use and modified by Dupuytren.

Dupuytren's mode of operating consists of two steps: puncture of the sac, and introduction of the canula. The first step is the same as that for temporary dilatation described above (Desmarres' method). In introducing the canula, the lips of the wound are kept separated by pressing upon the posterior wall with the blade of the bistoury; the canula being first slid upon its stylet is then passed into the sac and duct; the instrument, canula, being fairly entered into the duct, the bistoury is withdrawn, and the tube pushed onward until its superior extremity has disappeared in the lacrymal sac. The stylet is then withdrawn. In order to ascertain the situation of the canula in the sac and duct, the following test may be resorted to: the mouth and nose of the patient being closed, the surgeon requests him to make a strong expiration; if the tube is properly placed, a small quantity of blood mixed with air will be thrown out of the external wound. A piece of court plaster may be placed over the wound for a dressing.

Berard and Cloquet dilate the duct with tents, before introducing the canula. This precaution is useful; the parietes of the canal by this means become accustomed to the contact of foreign bodies, and consequently are much less exposed to the inflammatory excitement so common immediately after introduction of the canula.

The form of the canula has undergone numerous modifications. Pellier's had two rims, one at its upper extremity, the other in the middle; Dupuytren's instrument has a rim above, with a circular groove within to facilitate its extraction; Gerdy adds lateral projections, by which the canula is prevented from slipping out. To attain this latter object Riterick of Leipsic, and more recently Petriquin and Lenoir make use of a canula split longitudinally, so that its two sides, by their elasticity, tend to keep the instrument in its place Lenoir has invented an ingenious handle by which this canula is introduced into the duct, its two valves being compressed in a cylinder, which being withdrawn, they separate by their elastic spring, and press against the sides of the passage. The introduction of the canula is not always exempt from danger; it is frequently followed by an inflammation so severe in character, that the surgeon is forced to extract the instrument. Several of the stylets invented for extracting canulæ from the nasal duct are represented in the plates. (See Instruments, pl. VIII, fig. 5 and 14.)

6th. *Cauterisation.—Harveng* opened the sac in the ordinary way and cauterised its interior, either with a small cautery iron, or by introducing a tent covered with the nitrate of silver from below, through a canula.

Gensoul cauterises the canal from below upwards by means of curved sounds armed with nitrate of silver.

Lallemand (of Montpelier) opens the sac, and introduces into it a fragment of crystallised nitrate of silver of the size of a flax seed, and then closes the wound with a piece of court plaster; an eschar is produced in the interior of the sac and duct, which is discharged from its lower outlet.

Lallemand has employed this method successfully in the treatment of many obstinate cases.

The caustic holders and their conducting canulæ are represented in the plates of instruments (see pl. VIII, fig. 10).

§ 2. *Opening of an artificial canal.*—The methods which we have described above are frequently inefficient. A new passage may then be opened for the tears.

Wolhouse, by means of a semi-elliptical incision, made a large opening into the lacrymal sac, and extirpated it; he then perforated the os unguis with a pointed probe, and afterward introduced a small canula or a tent of lint to keep the perforation open.

Hunter used a cutting punch to perforate the os unguis. His method requires instruments made for the purpose, and is no longer employed.

Wathen made, with a drill, a new canal in the same direction as the natural duct, and introduced into it a permanent canula.

Laugier has proposed to perforate the maxillary sinus with a curved trocar (see Instruments, plate VIII., fig. 12), and place a canula into the opening.

§ 3. *Obliteration of the lacrymal passages.*—1st, *Nannoni* destroyed the sac. To effect this, he made a large opening into it, filled it with lint, and afterwards applied either caustic, or the actual cautery.

Bosche, relying upon the fact that the puncta are sometimes obliterated congenitally, without the individuals thus affected suffering much inconvenience from the flow of the tears over the cheek, cauterised the puncta by introducing into them a small quantity of nitrate of silver.

2d. *Removal of the lacrymal gland.—Paul Bernard* performed this operation successfully in a case of chronic flow of tears over the cheek, which he attributed to an excessive secretion from the lacrymal gland. The operation is performed in the following manner: a vertical fold is taken up beneath the orbit and on a level with the gland; this fold, being transfixed at its base with a fine bistoury, is cut completely through, leaving a longitudinal wound of about eight lines in length, through which the orbitar cavity is entered. The lacrymal gland is then easily detached and removed by the use of hooks and scissors.

Summing up.—The obliteration of the lacrymal passages, or the removal of the lacrymal gland, ought not to be resorted to until after attempting a cure by the means described above. These two methods must be considered as offering the last resources in the treatment of obstinate cases which have resisted all the other efforts of the surgeon.

Fig 1.

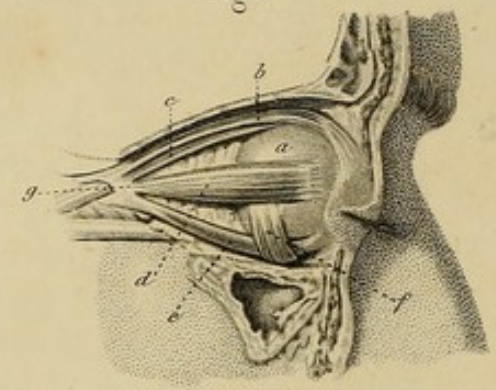


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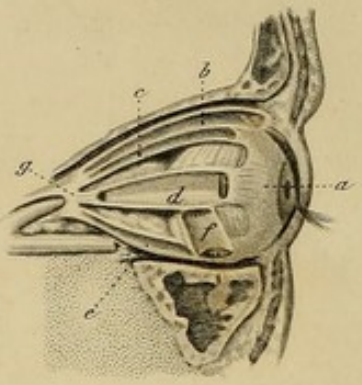


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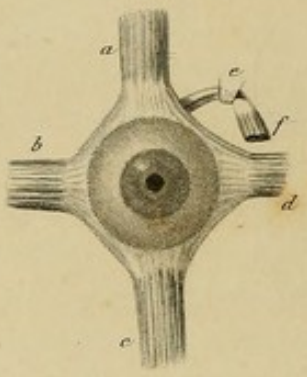


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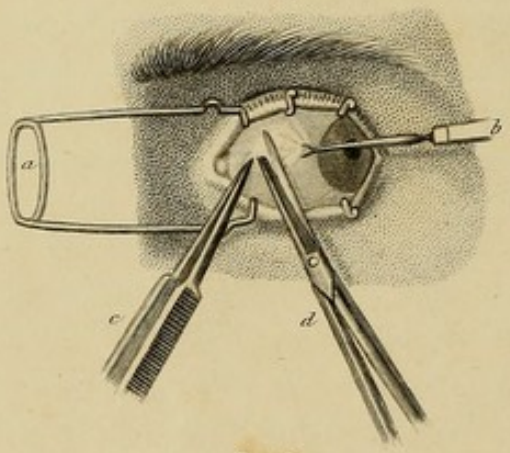


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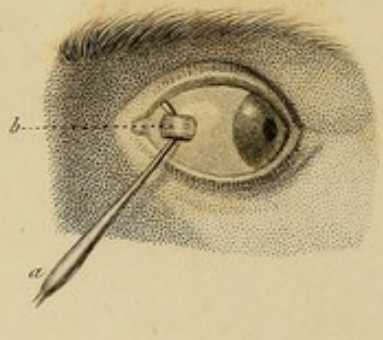


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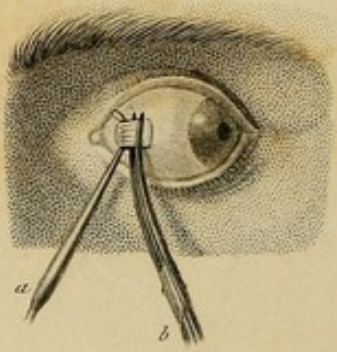


Plate XL.

OPERATIONS UPON THE MUSCLES OF THE EYE.

SURGICAL ANATOMY.

Fig. 1. *Antero-posterior vertical section of the orbit, exposing the muscles of the right eye; external aspect.*—*a*, globe of the eye; *b*, levator muscle of the upper eyelid; *c*, superior rectus muscle; *d*, rectus externus; *e*, inferior rectus; *f*, inferior oblique muscle; *g*, origin of the muscles of the eye.

Fig. 2. *Represents the aponeurotic sheaths formed by the orbitar aponeurosis.*—*a*, globe of the eye; *b*, sheath of the levator of the upper lid; *c*, sheath of the superior rectus; *d*, sheath of the external rectus; *e*, sheath of the inferior rectus; *f*, sheath of the inferior oblique muscle.

Fig. 3. *Arrangement of the muscles and their insertion upon the sclerotica; front view of the eye, with the muscles brought from behind forward.*—*a*, superior rectus; *b*, external rectus; *d*, internal rectus; *c*, inferior rectus; *f*, the superior oblique with its tendon passing through the pulley, *e*.

Fig. 4. *Operation for strabismus.*—*Sédillot's method.*—The eyelids are kept apart by an instrument made for the purpose, *a*; *b*, a double hook held by an assistant; *c*, forceps holding up a fold of the conjunctiva; *d*, scissors incising this fold to expose the muscle.

Fig. 5. A blunt hook, *a*, carried under the muscle, *b*.

Fig. 6. *a*, blunt hook; *b*, scissors cutting the internal rectus muscle.

The movements of the globe of the eye are performed around three axes, an antero-posterior, a transverse and a vertical. These motions are effected by six muscles, four straight and two oblique. The four straight muscles arise around the foramen opticum behind the globe, and enveloping it pass forward and are inserted into its anterior hemisphere, about one or two lines from the circumference of the cornea, a favorable arrangement for the movements of rotation, which they are destined to effect. These four muscles are:

1st. The *superior rectus*, situated at the upper part of the orbit, beneath the levator palpebræ superioris; it raises the pupil by turning the eye upon its transverse axis;

2d. The *inferior rectus*, diametrically opposed to the preceding, also turns the eye upon its transverse axis, by drawing down the pupil. It passes between the globe and the inferior oblique which is inserted above its external border;

3d. The *internal rectus*, situated along the internal wall of the orbit, turns the eye on its vertical axis, and draws the pupil inward;

4th. The *external rectus*, lying along the external wall of the orbit, is the antagonist of the preceding; its insertion into the sclerotica is a little nearer the cornea than that of either of the other recti muscles.

The two oblique muscles turn the eye around its antero-posterior axis.

1st. The *superior oblique* arises around the optic foramen; from thence it passes forwards and inwards to the internal orbitar process of the frontal bone, where it passes through a fibrous ring, which forms a species of pulley. After leaving this ring, it passes from within outwards beneath the superior rectus, and is inserted into the posterior hemisphere of the globe; when it contracts, it draws the pupil downwards and outwards.

2d. The *inferior oblique* arises along the inner edge of the border of the orbit; it passes beneath the globe from within outwards, and is inserted by a large tendon into the posterior hemisphere of the eyeball, below the insertion of the superior oblique, to which muscle its action is opposed.

Three different nerves supply these muscles: the *motores oculorum*, or third pair, give branches to the superior, internal, and inferior recti, and the inferior oblique; the *pathetici*, or fourth pair, supply the superior oblique alone, and the *abducentes*, or sixth pair, the external rectus.

Orbitar aponeurosis.—The eyeball is retained in the middle of the orbit by the orbitar aponeurosis. Suspended in this fibrous capsule, it executes with rapidity its movements of rotation, without sustaining any general displacement, which would destroy in the two globes that simultaneousness of motion so necessary to distinctness of vision. This aponeurosis, after lining the orbit and supplying the palpebral ligaments, is reflected upon the globe, envelopes its two posterior thirds, furnishes sheaths for its muscles, and finally terminates posteriorly upon the neurilemma of the optic nerve.

It is adherent anteriorly to the muscles at the point where they leave it to be inserted into the sclerotica. This arrangement does not always allow each muscle to act independently; it accounts for those movements which still continue after the section of the muscle itself, the movements of the eyeball depending in these cases upon those of the orbitar aponeurosis.

STRABISMUS.

MODES OF OPERATING.

Strabismus consists in a loss of parallelism between the two axes of vision.

There are four varieties of strabismus: the *internal* or *converging;* the *external* or *diverging*; the *superior* or *ascending;* the *inferior* or *descending.*

The indications for and against the operation are derived from the causes which produce the disease, the most frequent of which is, perhaps, contraction of the muscle corresponding to the direction of the squint. When the sound eye is covered, in the great majority of cases of strabismus, the affected eye immediately resumes its normal direction and motions; this affords evidence that the squint is not dependent upon tumour of the orbit, or of the globe, or upon paralysis of the third or sixth pair of nerves, or adhesions between the globe and eyelids, &c. The operation should not be performed, also, where there is artifical pupil, amaurosis, or cataract, or where the disease has been caused by nebulæ upon the cornea, &c.

When the strabismus depends upon paralysis of the sixth pair, the eye is turned inwards and cannot be directed outwards; in paralysis of the third pair the reverse is the case, and the upper eyelid is either totally or partially paralysed; double vision also exists.

The operation should not be performed without hesitation either upon old persons, or very young children; in the former the chances of success are very limited on account of the duration of the deformity and the rigidity of the tissues; in the latter the deformity is frequently relieved by simple means, or even outgrown.

Stromeyer's method.—We borrow from the author himself the following simple and precise description of the operation which he recommended in the year 1829 for the cure of strabismus: "The sound eye being closed, the patient is directed to carry the affected eye as far as possible in the direction opposite to that which it usually retains. If

the strabismus is inwards, a fine double hook should be inserted into the inner margin of the ocular conjunctiva, and confided to an intelligent assistant, who draws the eye outwards; the conjunctiva being raised up with the forceps, should be divided with a cataract knife, the incision being directed towards the inner angle of the eye; the traction outwards is then increased until the internal rectus muscle appears; a fine probe is then passed beneath the latter, and it is divided with the curved scissors, or with the knife with which the conjunctiva was opened."

Dieffenbach's method.—"The instrumental apparatus is very simple: Pellier's elevator; a blunt double hook for drawing down the lower lid; two small sharp-pointed hooks, for the conjunctiva; a pair of scissors curved on their flat-surface for cutting the conjunctiva; a simple blunt hook to be passed beneath the muscle, while it is being cut with the scissors which were used to incise the conjunctiva; a small sharp hook for the sclerotica, in case the eye should turn spasmodically in such a manner as to interfere with the operation; a sponge, and a little cold water.

"Two assistants are necessary, even when the operation is performed upon a quiet patient; more are required when the contrary is the case. The patient should be seated in a low chair, as in the operation for cataract, opposite to a window furnishing a good light, and the surgeon seated in front of him upon a chair somewhat higher. One of the assistants stands behind the patient, and supports his head steadily against his chest. Pellier's elevator is then introduced beneath the upper lid and committed in charge to this assistant; and a second assistant depresses the lower eyelid with the proper instrument, and at the same time keeps charge of the patient's hands; the sound eye is covered. (The case is supposed to be one of converging strabismus in the right eye). The surgeon now inserts one of the small sharp hooks into the conjunctiva near the caruncula lacrymalis and draws the eye outwards; if it resists, a second hook is inserted a line or two from the main edge of the cornea, the first being committed to an assistant. A fold of the mucous membrane being thus lifted up between the two hooks, the surgeon divides it freely with the curved scissors until the muscle is brought in sight; he then lays aside the scissors, takes the blunt hook, and passes it beneath the muscle, between it and the sclerotica, withdraws the sharp hook so as to free his left hand, which then takes charge of

the blunt one, and finally divides the muscle entirely across with the curved scissors first employed. When the muscle is properly divided, the eye generally resumes immediately its natural position.

"For the left eye the operator carries his left arm across the patient's forehead, and manages with his left hand the sharp hook first inserted into the conjunctiva, whilst the assistant who stands behind the patient holds the elevator in his left hand, and the other sharp hook in his right."

In cases of slight strabismus Dieffenbach has proposed to excise with the curved scissors a small flap including both the conjunctiva and the contracted muscle. Cullier advises the addition of sutures to excision, and employs the ordinary probe-pointed eye-scissors.

Phillips exsects the tendinous portion of the muscles.

Bonnet raises the conjunctiva with the forceps, and after dividing it, cuts the muscle with a small scalpel introduced between it and the sclerotica.

Velpeau seizes up with mouse-teeth forceps a large fold of the conjunctiva, together with the insertion of the muscle, into the sclerotica; if the operation is being performed upon the right eye, the surgeon holds the forceps himself; if upon the left, they are taken by an assistant. With another pair of mouse-teeth forceps a second fold is then taken up a short distance from the first. This second pair of forceps are held by an assistant. The fold between the two forceps should then be freely divided with blunt pointed straight or curved scissors. The operation may be finished with a single incision.

Lucien Boyer having noticed that after the vertical section of the conjunctiva the caruncula lacrymalis is drawn very deeply inward, proposes to make the incision in the conjunctiva horizontally, and above the transverse diameter of the cornea.

Sedillot's method.—Sedillot thus describes his method:

"In converging strabismus, to turn the eye outwards, we take up the conjunctiva with a simple hook; another hook is then introduced along the border of the sclerotica, and a little within the cornea; an assistant takes charge of this last hook while the surgeon withdraws the first. Raising up a fold of the conjunctiva a little to the inner side of the hook with a pair of ordinary forceps, we divide it with a single cut of the scissors, and then cutting one after another the fibro-cellular filaments which present themselves, we soon come to the muscle, whose reddish color contrasts strongly with the sclerotica. After carefully iso-

lating the muscle, we slip a blunt hook beneath it, and raising it slightly, divide it with the scissors.

"In slight cases of strabismus, we have intentionally left a portion of the muscular fibres undivided, and yet obtained a successful result, by covering the sound eye for four or five days, and forcing the patient to turn the operated eye outwards, to see objects through a circular opening in a piece of plaster."

Sub-conjunctival operation.—Guérin's method.—Take up with the hooks a fold of the conjunctiva, and entering a Z shaped tenotomy knife at its base, introduce it between the muscle and the sclerotica; turn the cutting edge of the knife from behind forward, and divide the muscle with a slight sawing motion. By this method, Guérin proposes to prevent the contact of the air with the wound, and to procure for it, as for all sub-cutaneous wounds, the benefits of an immediate and rapid reparation.

Plate XLI.

OPERATION FOR CATARACT BY DEPRESSION.

Fig. 1. *Antero-posterior section of the eyeball.*—*b*, transparent cornea; *c*, the anterior chamber; *d*, the iris; *e*, the crystalline lens; *f*, the capsule of the crystalline lens; *g*, the vitreous humor.

Fig. 2. *Depression of the cataract.*—First stage (right eye).—*a*, *a*, the fingers of an assistant holding up the upper lid; *b*, *b*, the fingers of the surgeon depressing the lower lid; *c*, the instrument held in the left hand and plunged into the sclerotica. Two of the fingers of the surgeon rest upon the cheek for support.

Fig. 3. *The same operation.*—Second stage.—The *needle*, *a*, is carried between the crystalline lens and the iris; the concavity of its point is brought in contact with the superior border of the crystalline lens.

Fig. 4. *The same operation.*—Third stage.—*Depression.*—The handle of the needle raised, *a b*, by a lever-like motion, so that its point depresses the crystalline lens into the vitreous humor.

Fig. 5. *The same operation upon the left eye.*—*a*, position of the needle in the first stage; *b*, position of the needle in the second; *c*, position of the needle in the third.

Fig. 6. *Reclination.*—The crystalline lens, *a*, thrown directly backwards, *b*, into the vitreous humor.

Pl. 41.

Fig. 1.

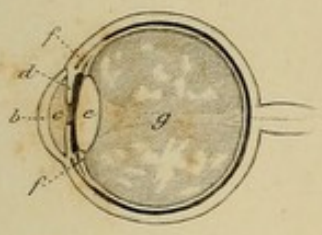


Fig. 2.

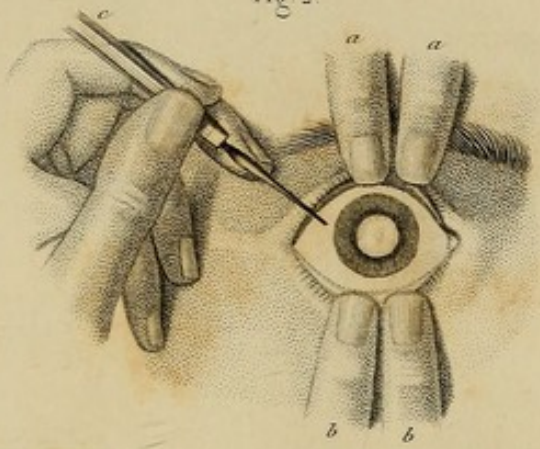


Fig. 3.

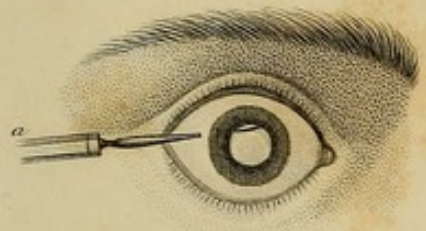


Fig. 4.

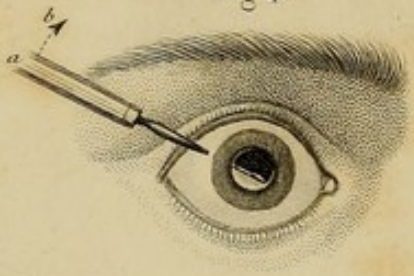


Fig. 5

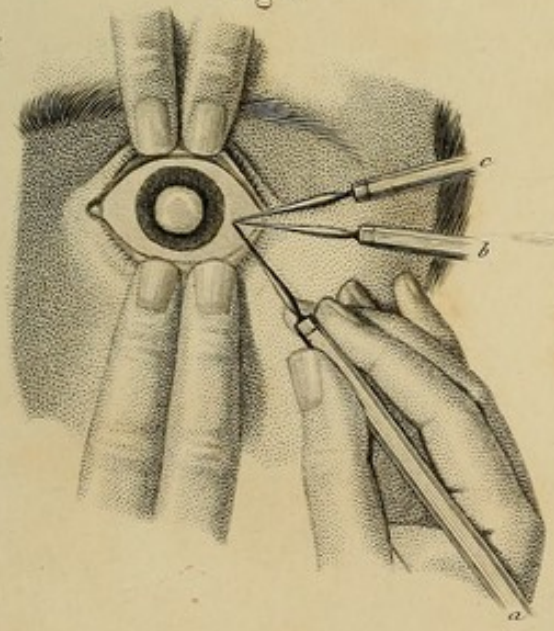
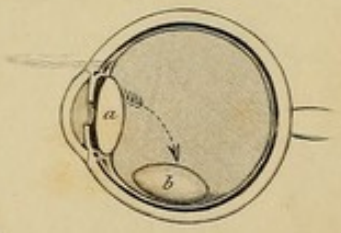


Fig. 6.



Pl. 42.

Fig. 1.

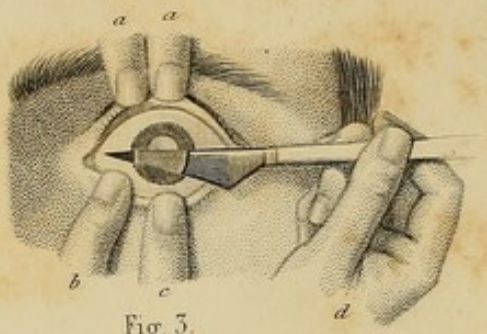


Fig. 2

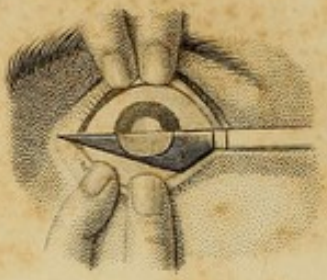


Fig. 3.

Fig. 4.

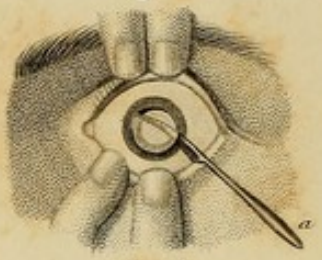


Fig. 6.

Fig. 5.





Fig. 7.

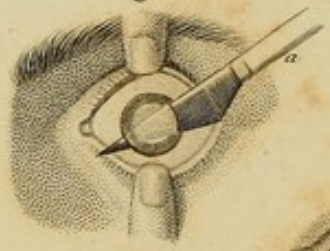


Fig. 8.

Fig. 10.

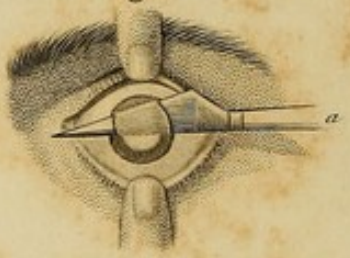


Fig. 12.



Fig. 11.





Fig. 9.

Fig. 13.



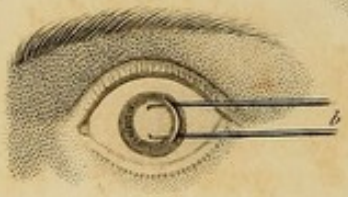




Plate XLII.

CATARACT AND ARTIFICIAL PUPIL.

Fig. 1. *Extraction of the cataract.*—First stage.—*Inferior section.*—*a*, *a*, the fingers of an assistant raising up the upper lid; *b* and *c*, the middle and index fingers of the surgeon depressing the lower lid; *d*, the right hand of the surgeon holding the cataract knife. The figure represents the point of the instrument immediately after it has passed through the cornea.

Fig. 2. *The same operation.*—The inferior flap cut out.

Fig. 3. *The same operation.*—Second step.—Incision of the capsule with the capsular knife, *a*.

Fig. 4 *The same operation.*—Third stage.—*Expulsion of the cataract.*—The handle of instrument, *b*, presses lightly upon the upper lid, while the surgeon compresses with his finger, *a*, the lower lid from below upward.

Fig. 5. *A finger armed with the claw.*—The claw of Desmarres for fixing the globe of the eye. *a*, the ring; *b*, small claws which are introduced into the sclerotica.

Fig. 6. *Oblique section.*—The knife, *a*, plunged obliquely from above downwards and from without inwards.

Fig. 7. *Superior section.*—The knife, *a*, carried transversely from without inwards; its edge, turned upwards, is cutting the superior flap.

Fig. 8. *Method of Furnari.*—*a*, the instrument of Furnari introduced into the anterior chamber, from without inwards.

Fig. 9. *The same method.*—Small hook like forceps seizing the opaque lens.

Fig. 10. *Artificial pupil.*—*Mulder's method.*—Crucial incision of the iris, and excision of the four small angles resulting from the incisions by means of scissors with an elbow at their joint.

Fig. 11. *The same operation.*—*Beer's method.*—A minute incision is made in the cornea; a small hook is tearing the iris and drawing it into the wound in the cornea.

Fig. 12. *The same operation.—Incision of the iris.—Velpeau's method.*—A lance-shaped knife, *a*, pierces first the cornea, then the iris from before backward; it is again thrust through the iris and cornea from behind forward. The edge of the instrument, looking downwards, cuts a flap in the iris and cornea.

Fig. 13. *The same operation.—Detachment of the iris.—Scarpa's method.*—A needle, *a*, introduced through the sclerotica is detaching the iris from above downwards.

OPERATIONS UPON THE GLOBE OF THE EYE.

SURGICAL ANATOMY.

We shall confine ourselves to a concise description of those parts composing the globe of the eye, which are important in reference to the operations which are performed on this organ. Proceeding from the periphery towards the centre of the eye, we meet with:

The *conjunctiva*, a delicate and vascular membrane, which after lining the inner aspect of the eyelids, is reflected over the globe of the eye, and covers all the visible portion of the sclerotica and cornea. At the internal angle of the eye, it forms a cul-de-sac of some depth before it is reflected upon the sclerotica. The transparent *cornea* is intimately united to the sclerotica. It is composed of laminæ laid one upon the other, between which the points of instruments may become engaged when they are not plunged at once through the cornea. The conjunctiva is tough and resisting, and the instruments which are used for cutting it should be of very superior quality.

The *sclerotica* extends from the optic nerve to the cornea. This envelope is of a pearly white colour; it is elastic and dense, so much so that in penetrating it, the point of the instrument should be introduced with a sudden and vigorous thrust, and at right angles with the membrane. The muscles of the eye are inserted into the sclerotica.

The *choroid* lines the internal aspect of the sclerotica, to which it slightly adheres. This membrane is composed of two distinct laminæ; one, internal, consists entirely of the coloring matter; the other, external, is essentially vascular. The ciliary vessels and nerves ramify between the choroid and sclerotica.

The *long ciliary arteries* which supply the iris are two in number, one internal, the other external. They are found between the choroid and sclerotica, in the plane of the transverse diameter of the globe, and

take their course horizontally from behind forwards. To avoid injuring them, the sclerotica should be punctured above or below the transverse diameter of the eye.

Between the choroid, sclerotica and iris, and directly opposite to the circumference of the cornea, is situated the *ciliary circle* or *ligament*, presenting the appearance of a greyish coloured ring. It is essentially vascular and interwoven with nervous filaments anastomosing with each other. In performing operations upon the eye, it should be carefully avoided.

The *ciliary processes*, folds formed by the internal lamina of the choroid, float behind the iris and surround the circumference of the crystalline lens, without possessing any intimate adhesions with it.

The *iris*, a diaphragm situated between the transparent cornea and the crystalline lens, separates this anterior portion of the globe of the eye into *two chambers:* one, *the anterior*, between the cornea and the iris; the other, *the posterior*, between the iris and the crystalline lens. The distance between the cornea and the iris is, at the centre, between a line and a line and a half. The distance between the iris and the lens is half a line, and not unfrequently they are in contact, which renders the passage of instruments between these two organs very dangerous for both.

Tne two chambers communicate with each other by the *pupil*, a circular opening in the centre of the iris. The greater circumference of the iris is in connection with the ciliary ligament, from which it can be easily separated. This anatomical arrangement is made use of in the operation for artificial pupil. The iris floats freely in the middle of the eye, as soon as instruments by their presence have destroyed the equilibrium of the pressure of the fluid by which it is maintained in its place. It is very necessary to avoid injuring this membrane, and to penetrate the anterior chamber very cautiously when operating for cataract by extraction.

The movements of the pupil have been variously explained by means of theoretical ideas concerning the structure of the iris. We refer to those theories which have originated particular methods for the operation of artificial pupil. The action of light and belladonna upon the iris are well known; we will point out the cases in which these two agents may be made useful.

The *crystalline lens*, situated behind the iris, is a double convex lens, ormed by concentric layers of unequal density, but which increase in

solidity as we approach its centre. The most external layer is almost liquid and has received the name of liquor Morgagni. The most concentric layer, or the *nucleus*, is of a gummy consistence, and easily crushed with the finger. On pressure, the lens easily separates into triangular segments, with their apices towards its centre. Each of these segments may be opaque of itself, or as a whole they may present different degrees of opacity, which gives to certain varieties of cataract their stellated or marbled appearance. The facility with which the crystalline lens is divided increases the difficulties in the operation by depression.

The crystalline lens is enveloped by a membrane or capsule, which, by its connections with the hyaloid membrane, and its contact with the ciliary processes, maintains the lens in its place. These relations often render the depression in mass of the crystalline apparatus very difficult, in cases of general cataract. In milky or lenticular cataract, it suffices to lacerate the capsule and permit its contents to escape.

Behind the crystalline lens is placed the *vitreous humour*, a gelatinous mass which fills the four posterior fifths of the globe of the eye. A very delicate membrane, the *hyaloid*, envelopes the vitreous humour, and by its numerous processes divides it into isolated cells of variable forms. To facilitate the operation for cataract by depression, it is frequently necessary to rupture with the needle some of these hyaloid cells.

CATARACT.

Cataract is a partial or total opacity of the crystalline apparatus. The different sources of the disease give rise to numerous varieties of cataract. We shall only mention those whose characters furnish indications for the choice of methods of operating.

According to its seat, the opacity may affect singly: 1st. the crystalline membrane, causing *capsular* or *membranous cataract;* 2d. the liquor Morgagni, giving rise to *milky cataract;* 3d. the crystalline lens, *lenticular cataract;* 4th. the lens and its capsule, *capsulo-lenticular cataract.*

Cataracts may be either *hard, soft or liquid.* Lenticular cataracts are usually hard and dark; they are common in old persons, and the operation by extraction is best calculated for their cure. Capsular cataracts are softer and clearer than the former. Milky cataracts are liquid, and are less opaque in the superior than in the inferior half of the capsule, their opaque particles obeying the law of gravity. Soft and liquid cataracts, being easily absorbed, constitute the varieties to which the operations of breaking up, and depression, are applicable. They are usually found in young persons; in the course of time the lens itself is liable to become opaque, and it is therefore advisable to operate for congenital cataract in infancy.

The *depth* of the cataract is indicated by the greater or less amount of shadow cast upon the opaque crystalline lens by the iris. In capsular cataracts, this shadow is slightly marked, and if it is entirely wanting, we may conclude that there is either contact or adhesion between the iris and the hypertrophied, or displaced crystalline apparatus.

Operative indications.—The general conditions of success are the following: satisfactory general health; healthy condition of the eye; absence of even slight inflammation of any of its tissues; cornea unblemished; moveable pupil; non-adherent iris; sensible retina; maturity of the cataract, proved by the entire loss of sight; existence of cataracts on both eyes, in order that the sound eye may not be endangered by the unforeseen and frequently unfavorable consequences of the operation when performed upon the diseased eye; operate upon children in infancy; a moderate atmospheric temperature; excessive heat or extreme cold are frequently prejudicial.

The object of the operation for cataract is to remove from the pupil the opaque body which prevents the rays of light from reaching the retina. The various methods by which this result is obtained may all be arranged under three principal heads: 1st. By *depression:* the opacity is simply displaced or broken up; 2d. By *extraction:* the opacity is removed from the eye; 3d. The *mixed method*, or the *operation of Quadri.*

General arrangements relative to the patient and the surgeon.— These are applicable to all cases, whatever may be the mode of operating adopted. The patient should be subjected for some time beforehand to a severe and debilitating regimen; all irritating causes which might give rise to an inflammatory state of the eye should be removed; light purgatives should be occasionally administered, in order to prevent cerebral congestion by creating a derivation towards the intestines; on the evening before the day fixed upon for the operation, a few drops of a solution of belladonna or atropine should be applied to the eye for the purpose of dilating the pupil, and if this dilatation should not continue until the moment of operating, a few drops more should be applied an hour or two before the operation. The use of belladonna is only absolutely necessary when the operation by extraction is to be performed. The patient being seated upon a low chair, the surgeon takes his place in front of him upon a little more elevated seat; an assistant standing behind, holds the head of the patient firmly, by passing one hand under his chin, and the other across his forehead. With the index and middle fingers of the hand upon the forehead, the assistant also raises the upper lid. This part of the assistant's duty is somewhat delicate; no pressure should be made upon the globe of the eye, and yet the lid must be so supported that it will not slip away and fall upon the instruments of the surgeon at the moment of operating; Desmarres advises rubbing the fingers with a little chalk to prevent the lid from slipping. The instruments used for elevating and depressing the eyelids when performing the operation for strabismus may also be had recourse to.

The surgeon, if he is ambidextrous, can easily operate upon either eye without changing his position; but should this not be the case, it will be necessary for him to stand behind the patient when performing the operation upon the right eye.

It is now necessary to fix the eye. For this purpose a small double hook may be used, which should be inserted into the sclerotica; but usually the surgeon obtains the necessary immobility by means of the index and middle fingers of the hand which is unemployed; the index depresses the lower lid, while the middle finger, carried a little upward and inward, upon the caruncula lacrymalis, makes moderate pressure upon the ball from within outwards. Desmarres has a ring upon his finger to which is attached a small flexible projection terminated by two claws, which he inserts into the sclerotica (see pl. 42, fig. 5).

§ 1. Depression.—This is performed with cataract needles (see Instruments, pl. IX., fig. 8, 9, 10 and 11). Scarpa's needle is a little more curved than that of Dupuytren, and has a projecting ridge upon its concave aspect. This ridge strengthens the point of the instrument, but increases the danger of dividing the lens, when pressing upon it in depression, by rendering it more liable to penetrate the substance of the cataract. The needle of Dupuytren, a little flatter and smaller at the point, has a conical stem, which gradually and exactly fills up the little wound made in its introduction, and thus the vitreous humour is less liable to escape. The handle of these needles is marked with a small black spot, on the same side as the convexity of the point, by which the surgeon always knows the position of the instrument when its point is buried in the eye. The operation by depression may be performed by introducing the needle into the eye through the sclerotica, *scleroticonyxis*, or through the cornea, *keratonyxis*. These are the principal methods, of which all others are only varieties.

A. *Scleroticonyxis.*—1*st stage. Puncture* (left eye).—The surgeon depresses the lower lid and fixes the eye, with the index and middle fingers of the left hand, then, taking the needle like a pen between the thumb, the index, and middle fingers of the right hand, he rests the two remaining fingers upon the cheek for a support. The needle is held a little obliquely from below upwards towards the sclerotica, its point being directed at a right angle to the surface which it is to penetrate; its convexity should look upwards, and the edges transversely, so that the little wound which is made will be parallel to the direction of the ciliary arteries. The patient being directed to turn the eye inwards, the needle is plunged into the sclerotica a line and a half or two lines from the cornea, and about half a line or a line below the transverse diameter of the globe. By making the puncture nearer the cornea, we would run the risk of wounding the iris and the ciliary body; by mak-

ing it more distant, we might perforate the lens, and render the manipulation by which the needle is brought behind the iris more difficult. Finally, by introducing the instrument below the transverse diameter, we avoid wounding the ciliary artery, which runs along between the sclerotica and the choroid, in the plane of this diameter. The puncture should be made firmly and at once, for at the moment when the first prick of the instrument is felt, the patients often make a sudden movement backward, which may either change the point of puncture, or disengage the needle already thrust into the eye.

2*d stage. Passage of the needle between the iris and the lens.*—The needle having passed through the sclerotica, should be carefully withdrawn until its curved portion only remains in the eye. Then, by rotating the handle of the instrument with the thumb, the concavity of the point is turned backward and the convexity forward; the black spot upon the handle indicates the extent of the movement. At the same time that this movement of rotation is being executed, the handle of the instrument is slightly elevated and carried towards the temple, so that the point turning around the inferior border of the lens, can, without injuring it, be carried between it and the iris. Contact or adhesions which may exist between the iris and the capsule render this manœuvre very delicate. The needle, brought to a horizontal position, is then turned from without inwards, so that its point may appear in the opening of the pupil.

3*d stage. Incision of the capsule.*—In the majority of cases the crystalline apparatus cannot be depressed in mass. The laceration of the capsule is especially necessary when the cataract is soft and of considerable volume. This manœuvre has besides the advantage of revealing the real nature of cataracts of doubtful character, and consequently furnishes timely indications for modifying the mode of operating (breaking up). This division of the capsule should be made with the edge of the needle, and is executed by making slight forward and backward movements beneath the inferior, and then upon the superior circumference of the envelope.

4*th stage. Displacement of the opacity.*—The capsule being divided, the concave face of the needle is brought to act upon the superior circumference of the lens, and by a slow and carefully managed lever-like movement, during which the handle is elevated and brought forward, the lens is carried downwards and outwards into the vitreous humour. The needle should retain it in this position for eight or ten seconds.

This displacement is executed with a moderate degree of pressure, in order to prevent the lens from rotating under the needle, which might cause its falling into the anterior chamber. Should this accident happen, the opaque body must be perforated with the needle and carried from before backward through the pupil. If the attempt to do this proves ineffectual, we must then have recourse to extraction by incision of the cornea.

To obviate the difficulties of this manipulation, Gerdy has invented a needle whose point being introduced into the eye, bifurcates at the will of the surgeon by the dilatation of the two branches which compose it; the lens is thus embraced and directed with greater certainty to the bottom of the eye by these two branches, which form a double support to it, and thus present any rotation on its axis.

B. Reclination is only a modification of the process just described. The needle carries the lens from before backward into the vitreous humour, and then depresses it so that its anterior becomes its superior aspect (see pl. 41, fig. 6). This variety of depression is applicable to soft cataracts when the capsule and the lens are displaced at the same time. After the depression it frequently happens that a few fragments of the capsule or the lens, separated by the pressure of the needle, are found floating in the middle of the eye. Each of them should be detached and carried into the vitreous or aqueous humour, in order to facilitate their absorption. By doing this we prevent the formation of secondary cataracts, which frequently result from the consecutive union of these particles.

C. *Breaking up.*—This method is especially applicable to soft and liquid cataracts. In this operation the capsule is lacerated, and its contents, if they are liquid, escape into the humours of the eye, where they are absorbed. If the cataract, although soft, can be divided into fragments, each fragment should then be divided into small particles, in order to submit it more thoroughly to the dissolving action of the humours of the eye.

When cataracts adhere to the iris, we must limit ourselves to the laceration of the capsule opposite the pupil. This operation is effected by means of a small hook which is slid flatwise between the capsule and the iris. When it has been introduced to the level of the pupil, the hook should be turned towards the capsule and made to act upon it in radiating lines.

D. *Suction.*—This method is applicable to soft cataracts only.

Laugier plunges into the cataract a hollow needle with an opening near its point. This needle is attached to a small syringe, whose piston being put in action, sucks the opaque humour from the cataract.

Blanchet operates by means of suction upon liquid cataracts; but he introduces his needle through the cornea, and instead of a syringe to draw out the cataract, uses a small india rubber vessel similar to that in the plate (see Instruments, pl. X., fig. 17), which being compressed and then left to its own elasticity, sucks out the opaque liquids with more or less rapidity.

We will now pass rapidly over the different secondary methods by which the operation by depression has been modified.

Petit of Namur, *Ferrein*, and, still later, *Bowen*, divide the capsule upon the posterior aspect of the lens; the lens alone is then depressed, and the anterior fold of the capsule remains in its place.

Bretonneau and *Velpeau*, after introducing the needle into the sclerotica, divide the hyaloid cells extensively before bringing it around the inferior border of the lens, thus preparing a way along which this body can be carried into the vitreous humour.

Bergeron and *Goirand* detach the lens from the vitreous humour around its entire circumference; then, after isolating it from the ciliary processes, carry it and the capsule into the vitreous humour together.

Pauli, and, still later, *Hervez de Chégoin*, propose to elevate the lens, instead of depressing it, upon the principle that its specific lightness is the only cause of its re-ascension after depression.

Malgaigne having noticed that the lens never re-ascends but when it has been depressed together with its capsule; and besides, that the capsule resists absorption for a long time, and that there is no great inconvenience produced by leaving it in its place, recommends the following method: Plunge the needle, with the concavity of its point looking upwards, into the sclerotica, at the place of election, and in such a manner that it will penetrate the posterior and inferior part of the lens; divide the capsule by carrying the needle backward, and then, with a half circle in the vitreous humour, bring the needle above the lens, in such way that its concavity looks downwards; by a slight pressure, the lens is forced downwards, and the two laminæ of the capsule close together behind it. The method is only applicable to lenticular cataracts.

E. *Keratonyxis.*—Depression through the cornea is only performed in rare cases where the eyes are deeply buried in their sockets, and of

such excessive mobility, that they can be fixed with difficulty. In this operation, all the movements of the needle are made through the pupil, where they chafe the borders of the iris; loss of the aqueous humour, the passage of the lens into the anterior chamber, cicatrices of the cornea, etc., are formidable accidents, and which, added to the difficulties of the operation, have long since caused the abandonment of the operation through the cornea in the majority of cases.

1*st stage. Puncture.*—An opaque cicatrix being the result of the wound, the puncture should be made near the periphery of the cornea, and the inferior half is to be preferred. Should there be an opaque spot on the cornea, this is chosen of course as the point for introducing the needle. The instrument should be carried through the cornea, one edge looking upward and the other downward, so as to make a small linear vertical wound.

2*d stage. Depression and breaking up.*—The point of the needle being introduced into the anterior chamber, by a movement of rotation its concavity is turned towards the lens. The capsule is then divided in the ordinary way, and the flat side of the needle being applied to the superior curve of the lens, is depressed into the vitreous humour by a lever-like motion, the handle of the instrument being directed upward and inward.

Breaking up.—The lens should now be transfixed by the needle, and an attempt made to break it up by rapid movements of rotation. Breaking up of the central portion of the lens is alone practicable when the cataract adheres to the iris.

§ 2. Extraction.—Extraction of the cataract may be effected by an incision through the cornea, *Keratotomy*, or through the sclerotica, *sclerotomy*.

A cataract knife, to incise the cornea; a needle or capsular knife, to divide the capsule; a small scoop, eye forceps, and a delicate pair of scissors, compose the necessary instruments (see Instruments, pl. IX., fig. 1, 2, 3, 4, 5, 6 and 7). Wenzel's knife is lancet-shaped; it has the convenience of incising the cornea and the lens at the same time, but the inconvenience of not completely filling up the wound which it makes when cutting the flap, which gives room for an escape of the aqueous humour. Richter's knife, in more common use, has a short and triangular-shaped blade, which closes exactly the wound in the cornea. The shortness of its blade renders it less liable to wound the internal angle of the eye.

The general arrangements and preparations already mentioned for the operation by depression are equally applicable to extraction.

The incision of the cornea makes a semi-lunar flap, which may be inferior, oblique, or superior; so that there are three methods; the operation by the inferior, the oblique, or the superior flap.

1. *By the inferior flap*—(pl. 42, fig. 1, 2, 3 and 4).—1*st stage.*—*Incision of the cornea* (fig. 1).—The point of the instrument is applied to the cornea on a level with its transverse diameter, and a half a line or a line in front of the sclerotica; with a sudden puncture, and a steady hand, it is made to penetrate the anterior chamber; a pause is then made to see that the knife has not wounded the iris; if this is not the case, the handle is carried a little backward, and the point directed horizontally from without inwards, along the transverse diameter, so that it will come out of the cornea on the other side at a point diametrically opposite to that where it entered; the blade of the instrument should be held parallel to the plane of the iris; the point having passed completely through the cornea, the knife should be pushed on slowly and with precision, not abruptly, so as to cut a flap whose borders will be everywhere equally distant from the sclerotica. Too much haste in this first stage of the operation may endanger the iris, or the loss of the aqueous humour. It is necessary that the muscles, which contract spasmodically from the influence of the puncture, should relax; and also that the knife should close the wound accurately as it advances, in order to prevent the escape of the aqueous humour (fig. 2). The flap once cut, the upper lid should be allowed to fall, and the patient given a moment of rest.

2*d stage.*—*Division of the capsule* (fig. 3).—The capsular knife, held like a writing pen, should then be introduced by its back from below upwards, through the wound in the cornea; its point being brought in contact with the capsule divides it lightly and without pressure, in order not to force back the lens. This incision of the capsule may be made with an ordinary cataract needle.

3*d stage.*—*Expulsion of the cataract* (fig. 4).—It frequently happens after the incision of the capsule, that the lens escapes of its own accord, owing to the contraction of the muscles which compress the globe of the eye. When this does not take place, pressing lightly upon the upper lid with the finger or the handle of the instrument usually suffices to force the lens into the opening of the pupil; it soon passes into the anterior chamber, and slips through the wound in

the cornea. Its expulsion may also be facilitated by means of two pressures combined, one upon the upper lid, and the other from below upward on the lower lid. Some particles of the lens or its capsule frequently remain in the field of the pupil; they should be extracted with the scoop, or the eye forceps, to prevent the formation of secondary cataracts.

2. *By oblique flap.—Wenzel's method* (fig. 6).—The point of the knife should penetrate the middle of the external and superior fourth of the cornea, and make its exit at the middle of the internal and inferior fourth. This method is more difficult of execution than the preceding; but the cicatrisation of the wound is more rapid; the lower lid is less liable to be caught under the flap, and there is less danger of wounding the nose, or the caruncula lacrymalis, in passing through the cornea.

3. *By the superior flap.—Methods of Richter, Wenzel, Jaeger, etc.* (fig. 7.)—This operation is performed in the same manner as that by the inferior, or oblique flap. The base of the flap corresponds to the transverse diameter of the cornea, and its free edge looks upward. This method, more difficult in its performance than the two first, has this advantage over them, that it is less frequently followed by the escape of the aqueous humour, and cicatrisation takes place rapidly, as the flap is retained in its proper position by the upper lid.

Furnari's method.—Furnari uses a double edged knife (see Instruments, pl. 9, fig. 5), terminated by a delicate point slightly curved on its flat surface. This little point is used to incise the capsule. The instrument penetrates the anterior chamber from without inwards (see pl. 42, fig. 8); the capsule is then incised, and through the opening made in the cornea, a delicate pair of eye forceps are introduced (fig. 9), with which the lens is broken up and extracted.

Sclerotomy.—This operation was proposed by Bell and has been since abandoned. An incision was made in the sclerotica; through this incision a pair of forceps were introduced, with which the lens was seized and removed. But this method exposes the ciliary arteries to lesion, to the instantaneous escape of the vitreous humour, to inflammation of the choroid, of the retina, etc., accidents which should give the preference to the operation through the cornea.

§ 3. Mixed method (*Quadri*).—The ordinary needle is introduced through the sclerotica, with which the lens is depressed or broken up; a small pair of forceps carried through the cornea, are used to divide the capsule and extract the fragments through the corneal opening. This method is generally rejected.

OPERATION FOR ARTIFICIAL PUPIL.

The operation for artificial pupil, performed for the first time by Cheselden in 1728, has, since that period, undergone an infinite number of modifications. The multiplicity of the causes which render this operation necessary, account for the number and variety of the methods in use. These have nothing exclusive in their character, and it is from the nature of the affections themselves which require this operation, that the surgeon must determine upon the method which he will adopt.

Four principal methods include all the modes of operating: 1st, the *incision of the iris* (iridotomy); 2d, *excision of the iris* (iridectomy); 3d, *detachment of the iris* (iridodialysis, or coredialysis); 4th, *displacement of the natural pupil* (corectopy).

Whatever method is adopted, the previous general preparations, the arrangement of the patient, the surgeons, and the assistants, are the same as those described above for cataract.

1st method. *Incision of the iris* (iridotomia or coretomia).—*Cheselden's method.*—Cheselden introduced a small sickle-shaped needle through the sclerotica, as in the operation for cataract by depression; the needle being fairly entered into the posterior chamber, he turned the point of the instrument towards the iris, and with a slight sawing motion made a horizontal incision of this membrane from behind forwards from a line and a half to two lines and a half in length. *Sharp* introduced the needle through the cornea. *Reichenbach*, *Odhelius* and *Richser*, incised the cornea and divided the iris from before backward.

Jurine introduces a needle through the sclerotica, and perforates the iris from behind forward, and again from before backward. These two punctures are then united by a single incision made by disengaging the needle downwards and backwards. This method, of very delicate execution, exposes the lens to injury, and may be followed by a greater or less detachment of the iris.

Janin having noticed that the horizontal incision of the fibres of the iris was almost constantly followed by reunion of the lips of the wound, determined to divide them across; to effect this, he introduced a small

knife, or a pair of delicate scissors, through the cornea, and made his incision vertical, and on the inner side of the natural pupil. Experience has shown that the pupils made by Janin's method close up as frequently, and are in no way exempt from the inconveniences attributed to the operation of Cheselden.

Compound section of the iris.—Whatever method is adopted, simple incisions of the iris are almost always followed by cicatrisation of the lips of the wound, which occasions an obliteration of the artificial pupil. To remedy this inconvenience the compound section of the iris is at present generally employed.

Guerin's method.—To unite the advantages of the methods of Cheselden and Janin, Guerin first opens the cornea, and then makes a crucial incision of the iris which divides its radiating fibres vertically as well as transversely.

Flajani's operation is analagous to that of Guerin; he uses the same needle to incise the cornea and the iris.

Maunoir also incises the cornea, and then, with delicate bent scissors, cuts a triangular flap from the iris, whose apex is at the centre and base at the circumference of that membrane.

Carron du Villars operates in the same way as Maunoir, but uses scissors without rings and which are kept open by a spring. The instrument of Carron du Villars is more easily managed than that of Maunoir.

Velpeau (see pl. 42, fig. 12,) uses an elongated double-edged knife, resembling very much the *serpent-tongued* lancet. The instrument transfixes the cornea; the point passes first through the iris from before backward and penetrates the posterior chamber; it is then brought from behind forward through the iris into the anterior chamber, about a line and a half or two lines from the first incision. The point is now carried anew through the cornea, and thus with a single thrust a flap is cut from the iris and the cornea. The small flap in the iris contracts upon itself, and soon disappears, leaving a triangular shaped artificial pupil.

Valuation.—The simple section of the iris is in general easily and quickly made; inflammation is less to be feared than in other methods, but it cannot be trusted, and the tendency which wounds of the iris have to cicatrise sometimes destroys the results of the operation, an inconvenience from which even compound section of the iris is not exempt.

2d method. *Excision of the iris* (iridectomia).— *Wenzel's method* (pl. 42, fig. 12).—This operation is the same as that of Velpeau described above, with the exception that Wenzel removes the little flap of the iris with the scissors, while Velpeau leaves it to itself.

Sabatier opens the cornea as in the operation for cataract, turns up the corneal flap, draws the iris outwards with forceps and excises it with scissors curved upon their flat surface.

Mulder, after making a crucial incision of the iris (pl. 42, fig. 10), removes one by one the small triangular flaps resulting from this incision.

Physick uses a pair of cutting forceps; one of the jaws is introduced behind, the other in front of the iris. These jaws being brought together remove a circular portion of the iris. Furnari uses an instrument similar to that of Physick.

Leroy d'Etioles operates upon the iris in situ, with an instrument similar in shape to the tonsil cutter. A small turning hook catches the iris and draws it between two rings, which, sliding one upon the other, excise the portion caught by the hook.

Beer makes a small incision in the cornea, through which he introduces a small hook which catches the iris and draws it through the wound in the cornea; with a delicate pair of scissors he excises this portion of the iris.

Gibson, *Walther* and *Lallemand* (of Montpellier), have variously modified Beer's method.

Desmarres incises the cornea with eye forceps, seizes a fold of the iris, draws it out through the wound and excises it.

Valuation.—Excision has this advantage over simple incision of the iris, that it is not followed by occlusion of the artificial pupil; but its execution is more difficult, as it necessarily requires more patience on the part of the patient, and greater firmness in the surgeon.

3d method. *Detachment of the iris* (coredialysis).—The facility with which the iris detaches itself from the ciliary ligament was taken advantage of for the first time by Assalini and Buzzi, in the operation for artificial pupil. Scarpa systematised this method, and introduced it into practice.

Scarpa's method (pl. 42, fig. 13).—A needle, *a*, is plunged into the eye through the sclerotica, as in the operation for cataract by depression; the point of the needle is carried to the superior and internal border of the iris, passed through this membrane from behind for-

wards, and with a see-saw motion, one-third of its circumference is detached by depressing it from within outwards.

Léveillé's method.—This method differs from the preceding only in the previous depression of the lens to avoid injuring it during the operation.

The methods of *Himly*, *Flajani* and *Beer*, consist in introducing the needle through the cornea, which facilitates the operation and allows the pupil to be made at any point of the iris. *Assalini* makes a large opening in the cornea, and detaches the cornea with eye forceps. *Bonzel*, whose method has been variously modified, detaches the iris with a small hook.

Langenbeck's method.—Impaction is united with detachment. An opening of one or two lines in length is made in the cornea, with an ordinary corneal knife; through this opening a small hook enclosed in a cylindrical sheath is introduced; the hook, slipped from its sheath, catches the iris and draws the detached flap into the wound in the cornea, where it contracts adhesions which prevent it from closing up the newly formed pupil.

Jungken, *Græfe* and *Reisenger* have modified Langenbeck's instrument, without changing his mode of operating.

Luzardi's method.—Luzardi invented a hooked needle consisting of two branches sliding one upon the other, but held together by a spiral spring (see Instruments, pl. 9, fig. 12). The needle is easily introduced into the eye, either through the cornea or the sclerotica, without any previous incision; when it is fairly entered, one of the branches is slid backward, which exposes a small hook with which a flap of the iris is seized; the spring, left to itself, forces the moveable branch against the hook, which thus grasping the detached flap, easily serves to draw it out through the wound.

Donegana's method.—Donegana unites incision with detachment. A small sickle-shaped needle, having a cutting edge on its concave aspect, is introduced through the cornea or sclerotica; the iris is detached with the convex border of the instrument, while with the concave cutting edge it is divided from its circumference towards its centre.

Huguier, remarking that when the iris is detached from the ciliary ligament, it folds before the instrument and is incised with difficulty begins by dividing it from the centre to the circumference, and afterwards detaching each lip of the wound.

Valuation.—All the operations through the sclerotica endanger the

crystalline lens; and so much the more, as the needle masqued by the iris is managed with difficulty, and may deviate from its course. By operating through the cornea, these dangers no longer exist, and every point of the entire circumference of the iris is equally accessible.

Detachment alone is not always followed by a success of long duration; the detached iris may unfold itself and obliterate the new pupil. It is therefore more certain to join impaction with detachment. The methods of Langenbeck and Luzardi being practicable with a simple hook, are applicable in the great majority of cases. Detachment is necessary when the iris adheres to the capsule, when there is anterior synechia, or when the greater portion of the cornea is opaque.

4th method. *Displacement of the natural pupil* (corectopia).—This displacement is applicable in cases where the natural pupil is masked by a spot upon the centre of the cornea. The object of the operation is to place the pupil behind a portion of the cornea which is not opaque.

Adams' method.—Adams made a small incision in the cornea, into which he drew the iris, to change the position of the natural pupil. When cicatrising, the wound of the cornea created adhesions which retained the iris and the pupil in their new position.

Himly, like Adams, makes an incision through the cornea, and draws the iris outwards with a small hook caught in the circumference of the natural pupil.

Guepin, of Nantes, and *Desmarres*, have invented a punch-like knife with which a small portion of the cornea is removed, and into which opening the iris falls; when the iris does not fall into this opening of its accord, it is easily forced into it by making a slight pressure upon the eyeball. The cicatrisation of the cornea creates an impaction of the iris.

Valuation.—Displacement of the natural pupil is easily effected; it is not liable to produce the inflammations which are to be feared in the other methods. But it is only practicable in those cases where the iris and pupil are both perfectly healthy.

SPOTS UPON THE CORNEA.

Spots upon the cornea are always the result of former ulcerative inflammation. These are perpetuated in the great majority of cases, by an inflammatory state of the cornea, during which, we may notice a vascular network converging toward the spot. It has been supposed

that these vessels perpetuate the opacity, and that their division or removal would be followed by the disappearance of the specks.

The surgeon, however, should not adopt the use of cutting instruments upon the cornea, until after thoroughly trying the ordinary methods of treatment. The operations which we are about to describe, require both prudence and great dexterity. Their employment is dangerous, and may occasion the loss of the eye.

1st. *Scarifications.*—These were first employed by *Demours*, who made four or five isolated, yet deep punctures with the point of a lancet, or a delicate bistoury, introduced obliquely into the spot. *Holscher* adopted this method to render a portion of the cornea transparent for an artificial pupil. *Richet* circumscribed the whole of the opaque spot with a circular furrow by carrying a cataract knife, whose point was introduced obliquely through half the thickness of the cornea, entirely around it. He then removed the small circular flap which resulted from the first stage of the operation.

2d. *Seton.—Pellier* and *Delarue* have published cases in which a flat thread passed between the laminæ of an opaque cornea, restored its transparency. The thread was introduced with a flat delicate needle. This operation is difficult in its performance, and exposes the patient to the gravest accidents. It is now completely abandoned. This is also true of *trepanning*, proposed by *Erasmus Darwin*, and of the *exsection* of the opaque flap, performed by *Dieffenbach*. We recall these dangerous operations from memory only.

3d. *Abrasion of the cornea.*—This operation, by which an ulcer is made to take the place of an opacity, is condemned by the majority of practitioners; yet it was adopted successfully in the case of a young girl, by Malgaigne. It should only be attempted upon persons who are entirely blind, and only upon them after the employment of every other means (Desmarres).

The eyelids being separated and the eye held firmly in its place, either with forceps or by means of hooks introduced into the sclerotica, the surgeon grasps the cornea with a pair of mouse-toothed forceps, and dissects from it a superficial flap with a cataract knife; by this method, which is always tedious and very painful, we run the risk of opening the anterior chamber. It should only be resorted to for the removal of *metallic spots*, produced by the injudicious use of badly prepared metallic colyria.

PTERYGIUM AND PANNUS.

Pterygium is a species of fleshy excrescence which attacks the cornea, and is usually triangular in form; its position is commonly towards the inner angle of the eye.

Pannus, less regular in its form, may attack any portion of the cornea. The same modes of operating are applicable to both.

The small excrescence is seized with a double hook, or a pair of mouse toothed forceps, and excised with a small scalpel or a pair of scissors curved upon their flat surface; it should then be cauterised with the nitrate of silver. These diseases frequently return, and are apt to leave an opacity of the cornea after them.

HYPOPION; PHLEGMON; HYDROPHTHALMIA.

§ 1. Purulent accumulations in the anterior chamber (*hypopion*) are easily absorbed in the great majority of cases; so puncture is rarely necessary. But should the nature of the case require it, it may be performed by introducing an ordinary cataract needle into the most dependant part of the transparent cornea.

§ 2. In cases of *acute phlegmon* of the eye, when the pain caused by the purulent accumulation has become intolerable, an exit must be given to the fluid. *Scarpa* made an incision in the centre of the cornea and cut out a circular flap, a proceeding which is both long and painful. It is preferable to open the cornea at its most inferior portion by a simple incision with a cataract knife. By this method, there is a chance of preserving some portion of the cornea transparent.

§ 3. *Hydrophthalmia*, when it greatly distends the globe, or when it is accompanied by intense inflammatory action, also requires a puncture of the eye. According to the case, the liquid may be entirely or only partially evacuated by a puncture made either in the cornea or the sclerotica.

Desmarres, for puncturing the sclerotica, uses a lancet shaped needle having two shoulders a short distance from its point, to prevent it penetrating too far. A channel is also cut in the blade by which the liquid can escape.

EXTIRPATION OF THE EYE.

Extirpation of the eye, the eyelids being preserved.—Ordinary method.—Carry an incision outward, two-thirds of an inch, or an inch,

from the external angle of the eyelids; draw these aside by dissecting up their internal surfaces; seize the diseased eye with a hook or a pair of Museux's forceps, plunge a bistoury in at the inner angle of the eye, and carry it from within outwards as close to the inferior aspect of the orbit as possible, repeat this process with the superior aspect of the mass, in order to thoroughly circumscribe and detach the tumour; exchange the bistoury for the curved scissors, and with them divide the pedicle which still attaches the tumour to the bottom of the orbit; this is the most simple and rapid operation for extirpation of the eye.

Dupuytren commences by detaching the tumour from the superior aspect of the orbit; then excising its pedicle, he draws it from behind forward, and completes its removal.

Should it be deemed advisable to remove the eyelids with the globe of the eye, they may be circumscribed with two semilunar incisions, and the operation completed as described above.

INSERTION OF AN ARTIFICIAL EYE.

The wound remaining after the extirpation of the eye having entirely cicatrised, a proper enamelled eye being chosen, the upper lid should be raised up and the most convex portion of the artificial eye inserted under it. The under lid should then be depressed, and both eyelids being finally left to themselves will support the artificial eye in its place. This eye, at first, should be retained but for a short time, so as gradually to accustom the soft parts to its contact. It may, finally, if too loose, be replaced by another still larger.

The *extraction* of the artificial eye is effected by means of a blunt gold or silver needle curved like a hook; the lower lid is depressed, and this instrument slid between it and the eye. A slight lever-like motion is then given to the needle, which displaces the artificial eye and causes it to slip from the socket.

Plate XLIII.

OPERATIONS UPON THE EAR.

Fig. 1. *A section showing the winding direction of the Eustachian tube, and of the external auditory canal.*—*a*, inferior turbinated bone of the nasal fossæ; *b*, middle turbinated bone; *c*, opening of the Eustachian tube, on a level with the attachment of the inferior turbinated bone; *d*, first bend formed by the Eustachian tube, which takes its course from this point more directly outwards; *e*, membrana tympani; *f*, external auditory canal, in its course from within outwards it completes the arch which would be formed by the continuation of the Eustachian tube, if projected externally in its original course; *g*, internal carotid artery.

Fig. 2. *Perforation of the lobe of the ear.*—*a*, perforator; *b*, a cork placed behind the lobe of the ear as a support.

Fig. 2 *bis*. Instrument for the perforation of the lobe of the ear; also used for the introduction of ear-rings.

Fig. 3. Extirpation of a polypus of the external auditory canal.

Fig. 4. Perforation of the membrana tympani; *a b*, Deleau's perforator; *c*, membrana tympani.

Pl. 43.

Fig. 1.

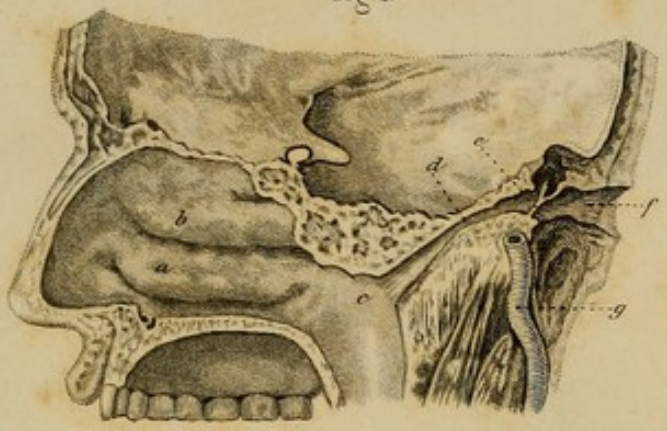


Fig. 2.

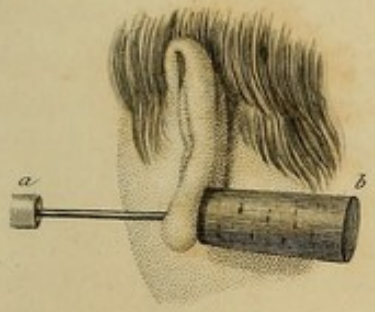


Fig. 2.bis

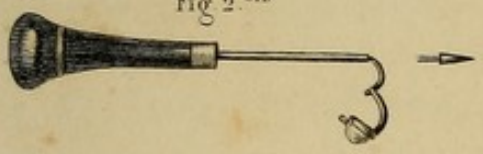
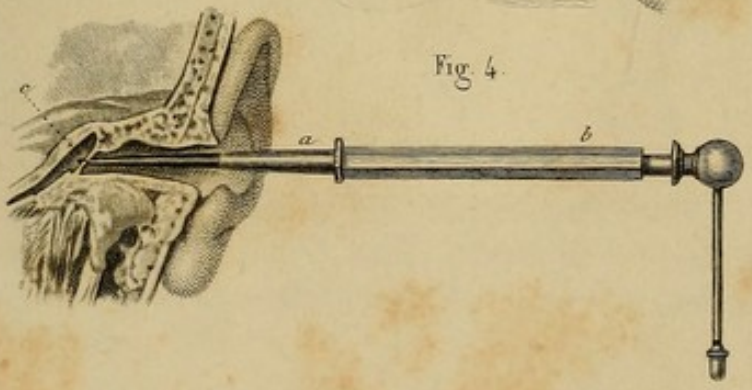


Fig. 3.



Fig. 4.



OPERATIONS UPON THE EXTERNAL EAR.

(*Pl.* 43, *fig.* 2 *and* 2 *bis.*)

PERFORATION OF THE LOBE OF THE EAR.

This operation, the object of which is the insertion of ear-rings, may be performed with a punch, or any sharp-pointed instrument. The operation is usually performed with a small trochar, fig. 2 *bis*, whose canula has a moveable point, and a cork, which is placed behind the ear as a support for the lobe.

The surgeon commences by compressing the lobe forcibly between his fingers to benumb it; then, taking the cork and holding it in its place with his left hand, he perforates the lobe at once from before backward with the trochar, which is buried in the cork. He then withdraws the cork and the stem of the trochar; the canula is left in the lobe, to aid in the introduction of a leaden wire or a silken cord, which is tied in the form of a ring, and allowed to remain until the wound is cicatrised and become converted into a permanent opening suitable for the reception of ear-rings.

WOUNDS OF THE EXTERNAL EAR, AND OTOPLASTY.

Simple wounds brought together by points of suture carried through the entire thickness of the *pinna*, usually unite by the first intention.

Otoplasty is only applicable to lesions of the lobe with loss of substance. The method by sliding (see Blepharoplasty) should be preferred, and in all cases, the flap which is destined to restore the loss of substance should be so attached that its cutaneous surface shall be directed outwards.

FOREIGN BODIES IN THE EXTERNAL MEATUS.

It would be difficult to enumerate the foreign bodies which might accidentally obstruct the auditory canal; they may be divided into two classes: 1st, bodies forming in the ear itself, wax more or less hardened, pus, coagulated blood, etc.; 2d, bodies introduced from without.

The extraction of these foreign bodies may be effected either with scoops, or forceps whose curves and dimensions are appropriate to the direction of the external auditory canal (see Instruments, pl. X., fig. 3, 4 and 5). The forms of these bodies, their solidity or softness, etc., will furnish indications to the surgeon, which will direct him in the choice of the proper method of operating for their removal. By drawing with the left hand the pinna of the ear upwards and outwards, we straighten a little the curves of the canal, and thus facilitate the introduction of instruments. By lubricating the canal with oil, the expulsion of the foreign body is more easily effected; if it should be solid, and tightly embraced by the soft walls of the canal, we may make use of specula (Instruments, pl. X., fig. 1 and 2) to dilate the passage, or introduce instruments from without for the purpose of crushing or cutting it in pieces. It must be remembered, as an anatomical fact, that in adults the vertical diameter of the canal is greater than its transverse diameter. Instruments therefore should be carried along the inferior wall of the canal, in order that they may be insinuated more easily between it and the foreign body. In infants, on the contrary, the transverse is greater than the vertical diameter. In the second place, the membrana tympani being inclined from above downwards and from without inwards, this arrangement should be recollected that the membrane may not be wounded, nor the foreign body forced into the angle which is formed at the internal extremity of the canal.

Hardened wax and analogous substances may be softened and removed by the use of injections of warm water. *Mayor* has also successfully used forcible injections for the expulsion of solid bodies, which the reflux of the liquid forced outwards.

If all these means fail, we may have recourse to the method of *Paul, of Egina*, who advises the surgeon to make a small incision behind the pinna, on a level with the canal, through which a probe can be introduced behind the foreign body, and used to force it from within outwards.

POLYPI OF THE AUDITORY CANAL.

Polypi of the auditory canal may be removed, or destroyed in situ, by ligature, excision, avulsion, and cauterisation. The nature of the polypus, its form and volume, should furnish to the surgeon the necessary indications for a choice of the proper method to adopt.

The ligature may be applied directly, or with the aid of Desault's knot-tyer (Instruments, pl. XII., fig 8) to a polypus with a pedicle.

Avulsion of the polypus is applicable to nearly all cases. It is effected with steel forceps (Instruments, pl. X., fig. 4, and pl. XII., fig. 1). The blood which frequently flows in abundance after the operation can be stopped by cauterisation. The nitrate of silver, or Vienna paste, is usually employed for this purpose. The action of the caustic should be carefully watched, and it would be prudent to introduce a small wad of cotton into the auditory canal to preserve the membrana tympani.

ABSENCE AND OBSTRUCTION OF THE AUDITORY CANAL.

The congenital absence of the meatus auditorius caused by the consolidation of its bony parietes, is beyond the resources of art. But when a membrane more or less thick, situated deeply, or otherwise, obliterates the canal, *puncture*, *incision* and *cauterisation* have been successfully employed.

It is always prudent to begin with an exploring puncture, to determine the existence of a cavity behind the membrane; if, by this puncture, the hearing is improved, a crucial incision of the membrane may be made, and the flaps exsected. Some dilating substance should then be introduced into the artifical opening to keep it patent, and prevent its obliteration during the healing of the wound.

Itard and *Bonafond* have made use of cauterisation by the nitrate of silver, for destroying deeply seated membranes (see the caustic holder of *Bonafond*, Instrument, pl. X., fig. 14).

The obliteration of the canal caused by the thickening of its soft parietes, may be cured by the use of dilating bodies, such as catgut, prepared sponge, etc., which may afterwards be replaced by a canula of gold, or ivory, to keep up the dilatation.

Whatever method is adopted, the surgeon should proceed carefully and be wary of creating lesions in the internal ear.

OPERATIONS UPON THE INTERNAL EAR.

(*Pl.* 38, *fig.* 1, *and Pl.* 43, *fig.* 1 *and* 4.)

PERFORATION OF THE MEMBRANA TYMPANI.

The object of this operation is to render the internal ear permeable to the air, in order to remedy the deafness which is caused by the complete and incurable obliteration of the Eustachian tube. Perforation of the *membrana tympani* may be effected: 1st, by *puncture;* 2d, by *excision;* 3d, by *cauterisation.*

1st. *Puncture.—Astley Cooper's method.*—A small curved trochar is carried along the anterior inferior wall of the external auditory canal, until it reaches the membrana tympani. The surgeon then suddenly thrusts the point of the instrument through this membrane to the extent of a line or a line and a half, and the patient immediately recovers his hearing.

Buchanan's method.—The operation is the same as the preceding, but the trochar used is square; the membrane being punctured, the size of the artificial opening is increased by rotating the instrument.

2d. *Excision.—Himly's method.*—The perforation effected by the methods employed by Astley Cooper and Buchanan is liable to close again. To remedy this inconvenience, Himly joined excision to puncture, by means of a punch, which has since been perfected by Fabrizi and Deleau (see Instruments, pl. X., fig. 12, 14 and 16).

Deleau's perforator consists of a canula whose extremity presents a circular cutting edge; this canula encloses a point whose base is also sharp. By turning a spring this point is forced through the membrane, and by the action of another spring as suddenly returns into the canula, cutting a circular flap from the membrane, which is caught between the canula and the base of the point (see pl. 43, fig. 4, application of Deleau's perforator).

3d. *Cauterisation* proposed by Richerand is now generally abandoned.

PERFORATION OF THE MASTOID CELLS.

The communication which exists between the mastoid cells and the

cavity of the tympanum has suggested the propriety of making an artificial passage for the external air by perforating the mastoid process.

This operation may be performed with a small trephine, a trochar, or a perforator. The most favorable point for the operation is a little in front of the mastoid process, and from seven to nine lines above its apex (Malgaigne).

Perforation of the mastoid cells is not only indicated in certain varieties of deafness, but may also be performed to give exit to pus or liquids contained in these cells or in the internal ear, the sequelæ of abscesses, or organic lesions of the bony tissue.

This operation does not always effect the results which it promises; it is not exempt from danger, and in some cases has been followed by death. These considerations, joined to the fact that the cells are frequently atrophied, which renders the operation useless, should render surgeons exceedingly cautious in determining to operate.

CATHETERISM OF THE EUSTACHIAN TUBE.

(*See Pl.* 38, *fig* 1, *and Pl.* 34, *fig.* 1.)

We must recollect that the Eustachian tube is a canal from an inch and a third to an inch and two-thirds in length, having an orifice, *c* (Plate 43, fig. 1), which looks downward, inward and forward, and is situated behind the inferior turbinated bone, *a*; the orifice of this tube may be reached, therefore, through the mouth, or by the nasal fossæ. Fig. 1st, pl. 38, represents Deleau's sound, *d*, lying upon the floor of the nasal fossæ, and introduced at *e*, into the pharyngeal orifice of the Eustachian tube.

The object of catheterising this tube is the removal of any obstructions which may exist in its cavity.

Guyot's method.—In 1724, Guyot, a postmaster at Versailles, operated successfully for the first time in catheterising the Eustachian tube. He introduced a sound into the tube by the mouth. This method had at first numerous partisans, but in 1741, *Cleland* introduced the operation through the nose, and Guyot's method was from that time generally abandoned.

Cleland's method.—Ordinary operation.—This is performed with a very delicate silver instrument, curved like a female catheter (see Instruments, pl. X., fig. 8). The patient being seated, with his head thrown slightly back, and firmly held by an assistant standing behind him, the

surgeon takes the catheter, previously oiled, in his right hand, and introducing it into the nostril on the same side as the tube which he intends to sound, carries it along the floor of the nasal fossæ as far as the velum palati. In this first stage of the operation, the beak of the catheter is directed downward and a little outward. After a passage of about two inches and a quarter, the beak of the catheter strikes the velum of the palate, which causes a disagreeable sensation to the patient, and provokes a sudden movement of deglutition. The beak of the catheter is then turned slightly upwards and outwards, by rotating its stem, which should always be kept close to the external wall of the nostril. By carefully making slight forward and backward movements, the beak is caught in the orifice of the tube. This result is indicated by the retention of the instrument, and the peculiar sensation experienced in the ear by the patient. To inject the tube, the catheter should be held firmly in its position by squeezing it between the nostril and the fingers, and introducing into its orifice the extremity of a small syringe.

Deleau's method (see pl. 38, fig. 1).—Instead of a silver, Deleau uses a gum elastic flexible catheter, which can be introduced more deeply into the tube without being stopped by the winding parietes of the canal (see Instruments, pl. X., fig. 11). A stylet introduced into the catheter serves to support it, and to give it the proper curve. The extremity of the stylet extending a short distance beyond the catheter, is first caught in the tube; the catheter, guided by the stylet, is then pushed on as far as possible, and the stylet is withdrawn. The external extremity of the catheter is terminated by a small silver lip, to which is fitted a piece of wire bent like a spring, which fixes the apparatus in its position by clasping the ala of the nose of the patient. When the catheter is fast, injections appropriate to the disease can be introduced through it. Deleau recommends injections of air above all others; to introduce them, he uses an india rubber bag (see Instruments, pl. X., fig. 17), which only requires to be compressed to force a current of air into the tube.

These *douches* of air may, in certain cases, be of valuable assistance to our diagnosis. In fact, the surgeon by applying his ear to the ear of the patient, can easily recognise when the air penetrates the cavity of the tympanum and returns between the catheter and the parietes of the tube; in such cases, the obstruction is not complete. If the current of air passes through the internal ear and comes out through the ex-

ternal auditory canal, there is a perforation of the membrana tympani. Finally, the rattles and gurglings which are perceived by this auscultation reveal the presence of purulent or other liquids in the internal ear, etc.

Another method of Deleau's.—When the nostril corresponding to the diseased tube is itself obstructed, catheterism may be effected through the other nostril, by increasing the curvature of the catheter, and adjusting the dimensions of the curved part to the distance to be traversed, in order to reach the orifice of the tube. To facilitate the introduction of the beak of the catheter, its convexity should be slightly straightened.

Gairal's method.—Gairal carries the catheter to the posterior extremity of the nasal fossæ; as soon as the beak of the instrument has passed beyond the floor of the nostril, he makes it describe a fourth of a circle upwards and outwards; the catheter being then carried a little farther on, its extremity is caught in the orifice of the tube, and continuing the slight movement of rotation outwards, the instrument is introduced still more deeply into the canal.

The lip of Gairal's catheter has divisions marked upon it which indicate the limits of the rotation which it is proper to make.

OPERATIONS UPON THE LIPS.

EXCISION OF A FOLD OF THE MUCOUS MEMBRANE OF THE LIP.

In some persons, whilst in the act of laughing, or even of speaking, a portion of the mucous membrane just within the free border of the lip protrudes habitually, forming an unsightly prominence and everting the lips to a greater or less degree.

To remedy this deformity, the transverse fold should be seized with the forceps, and excised with a pair of scissors curved upon their flat surface. Compresses, dipped in cold water or a solution of alum, and held between the lip and the teeth, usually suffice to arrest the slight hæmorrhage which sometimes arises from the operation.

SWELLING OF THE UPPER LIP.

If swelling of the upper lip exists as a symptom of scrofulous disease, we should limit ourselves to a general treatment for the diathesis, and abstain from any operation. But when an enlargement is found existing in an individual otherwise healthy, we may have recourse to *Paillard's* operation, by which the size of the lip is diminished by the removal of a flap of its internal mucous membrane. To do this, an assistant seizes one of the labial commissures and everts the lip by drawing it a little forwards; the surgeon with the hand which is disengaged does the same with the other commissure, and then with a bistoury removes a mucous flap of half its thickness throughout the whole length of the lip. The same dressing is applied, as for the operation last described.

Pl. 44.

Fig 1.

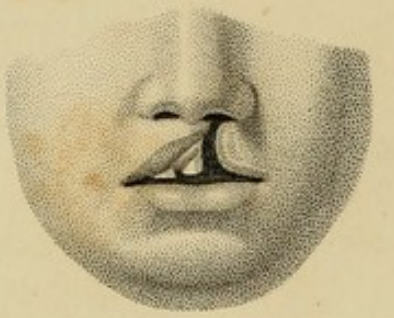


Fig 2.

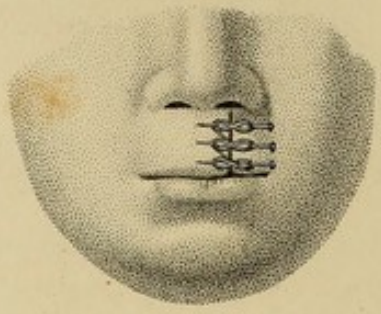


Fig 3.

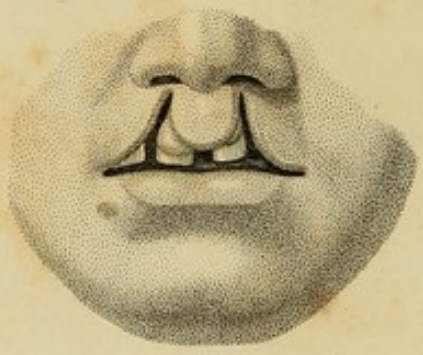


Fig 4.

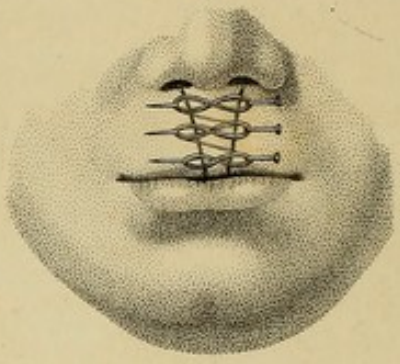


Fig 5.

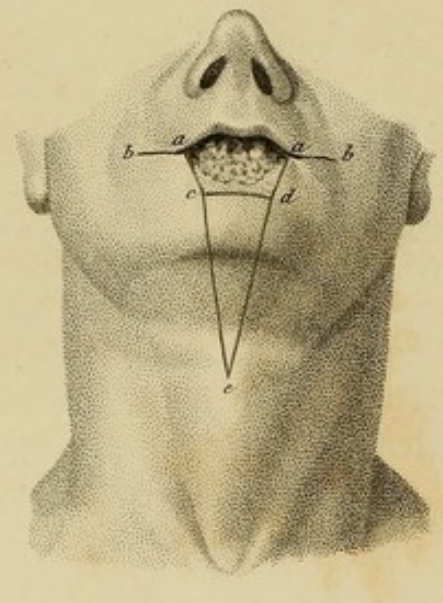


Fig 6.

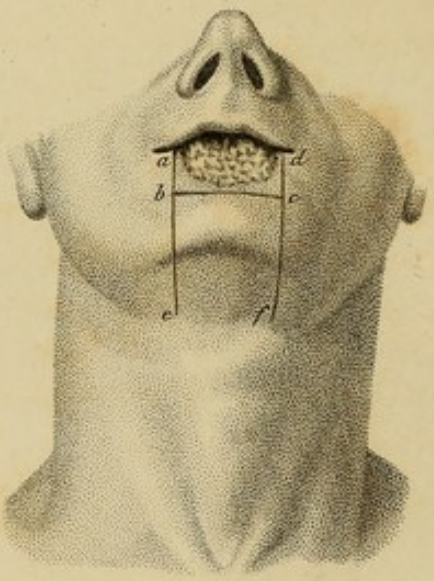


Plate XLIV.

HARE-LIP; CHEILOPLASTY; CONTRACTION OF THE ORIFICE OF THE MOUTH.

Fig. 1. *Simple hare-lip.*

Fig. 2. *The same after the operation.*—Three points of twisted suture unite the edges of the wound.

Fig. 3. *Double hare-lip.*

Fig. 4. *The same after the operation.*

Fig. 5. *Cheiloplasty.*—The cancerous portion, *a c d a*, is comprised between the two incisions, *a c e*, *a d e*. The commissures are prolonged by the two incisions, *a b*, *a b;* the two edges, *a d e*, and *a c e*, are brought together and united at the median line by points of suture.

Fig. 6. *Chopart's method.*—Two incisions, *a e*, and *d f*, form a quadrilateral flap, *a e f d*, from which the diseased portion is removed by the incision, *b c;* the flap, *b e c f*, by sliding, is then brought upward to a level with the commissures, *a* and *d*.

Plate XLV.

HARE-LIP CONTINUED, ETC.

Fig. 1 and 2. *Operation for hare-lip.—Malgaigne's method.*

Fig. 1. Two incisions, *a* and *b*, detach two small flaps with an inferior base, whose bleeding surfaces are brought together to fill up the small notch, or gap, which remains after the operation, when performed in the ordinary way.

Fig. 2. The two flaps, *a* and *b*, brought down before their union.

Fig. 3 and 4. *Method of Mirault, of Angers.*—A single flap, *a*, is preserved upon one of the borders of the division. This small flap is intended to fill up the notch (see fig. 4).

Fig. 5 and 6. *Contraction of the orifice of the mouth.— Dieffenbach's method.*—Two incisions, *a b* and *c d*, through half the thickness of the soft parts, form a triangular flap whose base corresponds to the retracted orifice and apex to the commissure of the lips.

Fig. 6. The flap is removed; the mucous lining, *a*, alone is preserved and lies at the bottom of the wound.

Fig. 7. The mucous lining is divided transversely; the two membranous flaps, *a* and *b*, are made use of to cover the raw edges of the wound, and form the mucous surface of the new lips.

Fig. 8. This represents a section of the parietes of the cavity of the mouth, in order to show the position of the threads, *a b* and *c d*, which are introduced before the division of the mucous lining, and intended for the points of suture.

RESTORATION OF THE ORIFICE OF THE MOUTH.

This operation is performed when there is an abnormal adhesion of the lips, or a contraction of the orifice of the mouth. If the abnormal adhesion is congenital and complete in a newly born infant, the mouth should be immediately opened by dividing the membrane which closes it. For this purpose, a puncture should be made with a straight bistoury at one of the points which corresponds to the commissure of the lips,

Pl. 45.

Fig 1.

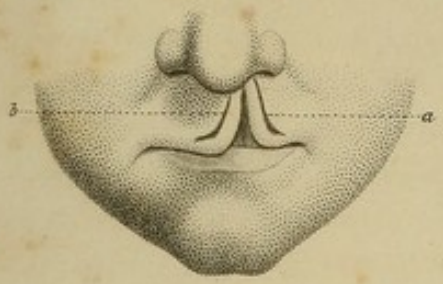


Fig. 2

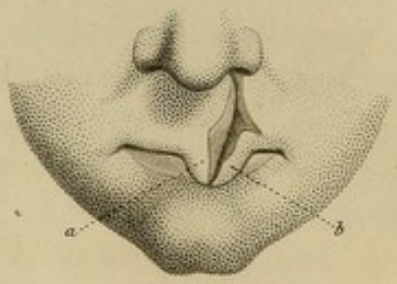


Fig. 3

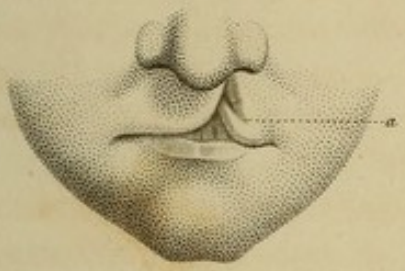


Fig 4

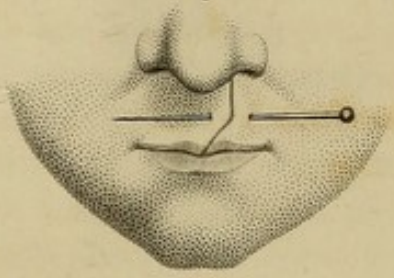


Fig 5

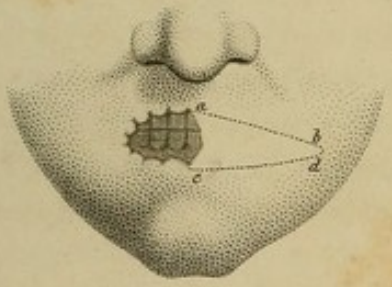


Fig 6.

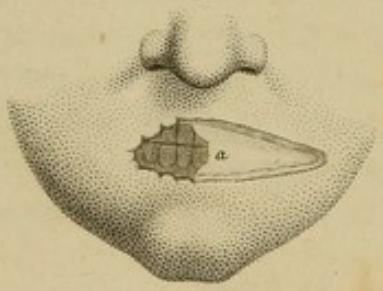


Fig 7

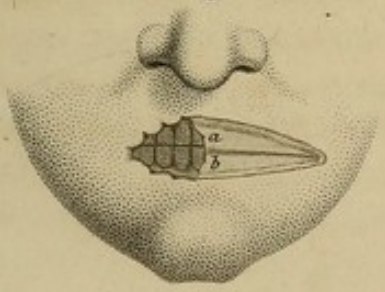
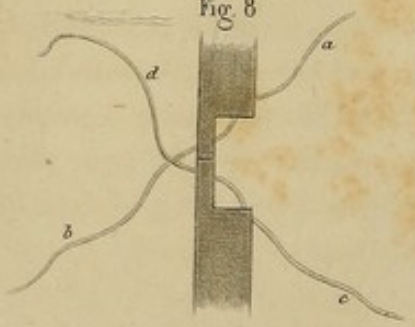


Fig. 8



and a director introduced through this opening as a guide for the cutting instrument (whether bistoury or scissors), with which the operation is to be performed. The two bleeding lips are now to be covered with a small fold of linen spread with cerate, to prevent all contact between the wounds during the process of healing.

When *contraction* of the mouth is produced by bad cicatrices, the result of burns, or ulcers, the success of an operation is more doubtful than in cases of abnormal adhesion. The process of cicatrisation creates new adhesions which have a tendency to re-produce contraction. To prevent these cicatrices from again establishing this deformity, the operations which we are about to describe have been devised.

Boyer's method.—The orifice of the mouth being re-established by means of incisions carried as far on either side as the course of the labial arteries will permit, the two commissures are drawn outwards by means of two blunt silver hooks, pulling one against the other. An appropriate bandage is made use of to support the hooks firmly in this position, and they keep up the dimensions of the mouth while cicatrisation of the lips is taking place. This method has had a fair share of success.

It has been proposed to make a puncture with a trochar on a line with each commissure; then to pass through these artificial openings a leaden wire whose extremities are to be brought together, and twisted and tightened every day, in order to cut through the intervening soft parts, but the divided tissues cicatrise and re-unite after the passage of the wire.

Krügen-Hausen's method.—The leaden wire is not inserted to divide the soft parts; it is left in its place without tightening, and when the two little apertures through which it passes are healed and have become permanent openings, the orifice of the mouth is established with the bistoury; the two cicatrised openings form the commissures. By this operation the results of cicatrisation are less to be feared than by the preceding method. In the place of the leaden wire, a small silver canula may be introduced, or one of Scarpa's leaden styles (see Instruments, pl. VIII., fig. 13), the largest extremity of which is in the mouth, and the point being bent over protrudes externally.

Dieffenbach's method (see pl. 45, fig. 5 and 6).—In order to prevent the edges of the wound from again uniting, Dieffenbach invented a method by which the mucous membrane is preserved, and employed to cover the raw edges of the newly formed lips.

The surgeon introduces the index finger of his left hand into the

mouth of the patient, to put the parietes of the cheeks upon the stretch; the other hand, holding a pair of sharp-pointed scissors, or better still, a sharp-pointed straight bistoury, introduces the extremity of the instrument obliquely a little above the place where the commissure of the lip should be situated; the blade of the instrument should not be forced entirely through the cheek, but carried from without inwards, through half the thickness of the tissues, until it reaches the contracted orifice of the mouth. The point of the instrument being disengaged, its edge should be turned in front, and with a single cut all the superficial half of the tissues are divided from behind forwards. A second incision below the first is then made in the same way, and the two are united at the point intended for the new commissure by a small semilunar incision. The triangular flap, *a b c d*, lying between these two incisions must now be excised, care being taken not to injure the mucous membrane which lines the bottom of the wound.

The second step of the operation consists in putting to its destined use the mucous membrane which has been preserved. For this purpose, it is isolated from the other tissues as much as possible, then divided horizontally to within two or three lines of the commissure. These two flaps, one above and the other below, are then turned over the raw edges of the wound, and united to the skin by delicate points of suture.

Velpeau's method.—Before the horizontal division of the mucous membrane, Velpeau inserts the threads which are to be used for sutures. Each thread, attached to a needle, is carried from within outwards through the mucous membrane and the skin. A row of threads for the upper, and also one for the lower lip are thus inserted; between these two rows the incision of the membrane is made, and union is effected by tying the threads (see pl. 45, fig. 8).

Method of Serres, of Montpellier.—Serres divides the skin and mucous membrane at the same level, and then brings the two membranes together and unites them by points of suture. This method is more simple than the preceding, but it does not offer the same prospects of success.

HARE-LIP.

The operation for hare-lip consists of two principal steps: 1st, the paring of the edges of the division; 2d, bringing them together and causing their union by the process of adhesion.

1st. *Paring the edges.*—The patient, if he is an adult, may be seated

upon a chair, with his head thrown slightly back, and held in this position by an assistant; if the patient is a young child, he should be wrapped in a sheet or towel, and held upon the knees of an assistant. The assistant holding the patient's head should push the cheeks forward as far as possible, and compress the facial arteries upon the lower jaw in front of each masseter muscle. The surgeon commences the operation by elevating the upper lip, and dividing with the bistoury, or a pair of scissors, the frænum which unites it to the gums. The angle of the left border of the division is then seized with the fingers or a pair of hooked forceps, and drawn a little forward and downwards, and now, with a pair of strong and very sharp scissors, all the red border of the division is incised with a single cut, which is carried one or two lines beyond its superior limits. The right border is then excised in the same way by an incision which joins that of the other side. These two incisions form an inverted V, whose branches enclose the borders of the unnatural cleft.

2d. *Re-union.*—The cut edges of the wound are now brought together and united by three points of twisted suture applied in the following manner: the inferior angle of the left flap is seized as above and a pin is introduced obliquely from below upward, and from without inwards, upon the line of junction between the vermilion border and the common integument, and comes out by the bleeding surface of the lip. The pin should pass through between the two anterior thirds and the posterior third of the thickness of the lip, entering from two to three lines beyond the edges of the wound, and coming out of the wound about a line above the mucous border of the lip. The angle of the flap is then transfixed by the same pin, but from above downwards and from within outwards, entering by the bleeding surface and coming out by the vermilion border of the lip.

This first pin describes a curve with its concavity downwards, for the purpose of causing a projection below of the two angles of the flap, in order to prevent, if possible, the small notch which almost always remains on the border of the lip after the union of the flaps. Some surgeons, instead of introducing the first pin at the vermilion border of the lip, carry it through the skin half a line or a line above it.

The first pin being introduced, and union maintained at this point by means of a thread carried around it in the form of a figure of 8, the second pin is inserted in a similar manner above the first, and in a horizontal direction, equi-distant from the first pin and the superior

angle of the wound. The third pin is inserted in the same manner above the second (see pl. 44, fig. 2). Between these pins strips of adhesive plaster may be attached, which will bring the cheeks forward and assist in maintaining the union. Finally, the points of the pins should be cut off, and small pieces of adhesive plaster applied between them and the skin to prevent irritation. A small piece of linen spread with cerate, and a little lint, are all the dressing which will be required.

For the first few days the patient should be kept alone as much as possible, in order to withdraw him from all external influences, which, by exciting either crying or laughter, might endanger the union of the wound. Liquid aliments alone should be used, and if the patient be a very young child, he may be entirely deprived of food for the first two days without injury. The wound itself should be an object of special care, for young infants may suck and swallow the blood which is flowing from it unnoticed. On the third or fourth day, the lower pin may be withdrawn, by turning it upon its axis, to avoid a painful drawing upon the wound which might have the effect of separating the newly united parts. On the next day, the middle pin may be withdrawn; and on the day after, the upper. The adhesive straps should be allowed to remain until the ninth day.

Malgaigne's method (see pl. 45, fig. 1 and 2).—"Although in the ordinary method which we have described above, the lower pin is so inserted that it causes a projection downwards of the two angles of the divided lip, yet the notch is almost always present after union in a greater or less degree. To remedy this defect, Malgaigne proposes the following method:

"Everything being arranged as in the ordinary operation, the edges of the lip are removed from above downward, either with the scissors or the bistoury, by carrying the incision at first exactly parallel to the edges of the hare lip; then, having reached the rounded angle which terminates them, the incision is curved so as to take a direction parallel to that of the angle, and is carried for a line or a line and a half along the natural border of the lip, until it reaches the point where this border takes its natural horizontal direction. These two flaps thus formed are supported by a delicate pedicle which easily admits their being turned from above downwards, so that their bleeding surfaces will look toward each other. The first pin, which must be very strong, should be inserted at the bottom of the lip, so as to bring together the two angles formed by turning down the flaps; one or two more pins should

also be inserted above the first. The main part of the lip is thus brought together, and the only thing now required is to give to the free border its proper shape.

"To do this, the surgeon brings together the pedicles of the two flaps. Sometimes the incision has not been carried low enough down, and the flaps which are turned down do not take a direction parallel with the rest of the cut edge of the lip; if such be the case, the incision must be prolonged downward and to one side, until the requisite direction is obtained. Then, preserving so much of the flap as is necessary to prevent the notch, the superfluous portion is cut away with the scissors: it is advisable, on account of the contraction of the cicatrix, to leave the flap half a line longer than appears necessary. The flap should be brought together with a needle, or with points of interrupted suture. If the hare-lip extends only through a part of the depth of the lip, it should be prolonged a little in the direction of the nostril, so as to obtain an easier and more exact co-aptation of the superior angle. If the frænum descends too low, it should be cut without hesitation." (*Manual of Operative Surgery.*)

Method of Mirault, of Angers (see pl. 45, fig. 3 and 4).—The edge of one of the borders of the cleft is entirely removed. A flap with a pedicle below is cut on the other border. The bleeding edges of the hare-lip are brought together, and the flap which was preserved is applied from below upward upon the notch.

DOUBLE HARE-LIP.

(*Plate* 44, *figures* 3 *and* 4.)

If the middle projection is not large enough to be readily pared, it is advisable to remove it entirely, and perform the operation already described for simple hare-lip. But if this projection is large enough to be preserved, its edges as well as those of the lateral divisions must be pared off. They are then brought together with pins, which should be carried through the lateral flaps and the tubercle. Their union presents a cicatrix in the shape of a V or a Y. It may happen that the middle projection is too large for a single pin to be carried through it and also bring together the two lateral divisions at the same time. In such cases, isolated points of suture may be inserted on each of the branches of the V shaped incision which forms the wound. The notch which remains after the operation for double hare-lip is usually larger than that after single hare-lip. The methods of Malgaigne and Mirault,

modified according to the nature of the case, are also applicable to this affection.

COMPLICATED HARE-LIP.

The most common complications of hare-lip are: 1st, the presence of teeth projecting forward; 2d, the abnormal projection of the os incisivum; 3d, the faulty direction of the median tubercle, and the irregularity of the border of the lip; 4th, a cleft in the velum palati, or roof of the mouth.

1st. *The projecting teeth* should be forced back and maintained as much as possible in their normal position by means of threads fastened to the adjoining teeth; if this cannot be effected, they must be extracted.

2d. *The abnormal projection of the os incisivum* is a complication which can be remedied in different ways. If the bone is moveable, it should be forced backward; if it is firm, it must be exsected.

Desault forced back the osseous tubercle by means of a bandage very tightly applied, which was carried over the projecting portion and fastened on the back side of the head. The patient wore the bandage until the bone was sufficiently reduced to allow the operation to be performed in the ordinary way. *Gensoul* has corrected the abnormal direction of the intermaxillary bone by fracturing it, by which he was enabled to give it a vertical direction. Whatever method may be adopted, the operation should not be performed until after the unnatural projection of the os incisivum has been rectified.

Blandin, with a pair of strong scissors, excised a triangular portion, with its base downwards, from the partition of the nasal fossæ. The intermaxillary bones thus deprived of their support, were then forced backward.

3d. *The faulty or abnormal insertion of the central labial tubercle* at the bottom of the nose, frequently depends upon the projection of the osseous tubercle to which it is attached; in such cases, the labial tubercle may be used to form the columna of the nose. *Dupuytren* divided the adhesions of the labial to the osseous tubercle with a bistoury; he then exsected from the latter all that portion which projected beyond the bones of the upper jaw; and, after paring the edges of the cutaneous tubercle, as well as the lateral borders of the cleft, he proceeded to bring them together as in simple hare-lip. The cutaneous tubercle was carried upward beneath the nose, and fastened in the place of the columna by points of suture.

4th. *Division of the vault of the palate.—Phillips' method.*—When there is a separation of the bones, Phillips inserts a silver wire armed with a steel point through the base of the nose, behind the alæ; two small plates of pasteboard or cork previously applied to the alæ of the nose, are also transfixed by the silver wire. The wire is then bent upon the pieces of pasteboard, which serve as a support for it, and the nose is thus embraced between two buttons, which approximate the parts whose union is about to be attempted.

REMOVAL OF CANCERS OF THE LIP AND CHEILOPLASTY.

Cancroid excrescences and superficial tumours developed on the free borders of the lips, may be excised with scissors curved on their flat surfaces. The small tumour should be seized and drawn out with hooked forceps, and excised, the incision being extended a short distance into the healthy tissues. The wound usually cicatrises very well of itself. If deemed advisable, the wound may be cauterised by the application of Cauquoin's, or the arsenical paste.

Larger tumours, which comprise a larger amount of the substance of the lip, should be included between two V shaped incisions, which can be made with the scissors, or the bistoury After the removal of the tumour, the two borders of the V shaped incision are brought together by points of suture. This method is applicable to tumours of moderate size. There may be some difficulty in bringing together the edges of the flaps; to increase their extensibility, they may be dissected up and isolated from the subjacent tissues.

Large and irregular tumours require special operations, the character of which, the surgeon must determine upon from the nature of the case. The removal of these tumours always occasions a considerable loss of substance, which should be repaired by one of the methods for the operation of cheiloplasty.

CHEILOPLASTY OF THE LOWER LIP.

The Italian and Indian methods are less employed than the French operation by sliding the flap. Whatever method is adopted, it is important to preserve as much of the mucous membrane as possible to cover the new lip.

Chopart's method (see pl. 44, fig. 6).—The tumour is included between two vertical and parallel incisions, commencing at the free border

of the lip, and carried as far downward as the os hyoides. These two incisions form a quadrilateral flap which is dissected up from above downwards. This dissection being concluded, the diseased portion of the flap is removed by a transverse incision. To repair the loss of substance occasioned by the removal of the tumour, the head of the patient should be brought forward, and the flap raised to a level with the commissures, or to the remaining portion of the lower lip. The flap is kept in place by points of suture inserted along the two vertical wounds. If any portion of the mucous membrane has been saved, it is to be used to cover the new lip. Should the free border of the lip be healthy, it may be preserved by carrying the incision for the removal of the diseased parts below it, and then be joined to the quadrilateral flap which is brought up from below. (Vignerie.)

Method of Roux of Saint Maximin.—The tumour being removed by a semilunar incision extending from one commissure to the other, M. Roux dissects up the integuments below; he then separates them from the lower jaw and carries the dissection as far as the os hyoides, proportioning its extent to the loss of substance which it is destined to repair. The skin of the chin forms a sort of moveable pocket in front of the lower jaw, or an apron which can be raised up to the proper level of the lower lip and supported in this position by means of strips of adhesive plaster or by a bandage, until perfect cicatrisation has taken place. If the tumour extends over the cheek, the commissures should be divided, and the semilunar incision should be prolonged until it reaches the external extremity of this division.

Morgan's method.—To facilitate the dissection of the flap which is to be brought up from below, Morgan has modified the preceding method, by making a vertical division of the integuments, commencing at the middle of the semi-lunar incision. Two flaps are thus formed, which can be easily dissected up, raised to the level of the commissures, and united along the median line by points of suture.

Malgaigne's method.—"All the diseased parts should be first removed, either by a V shaped incision, or by two vertical incisions carried as far as the base of the lower jaw, and there united by a transverse section.

"If the V incision is adopted there will be a triangular shaped loss of substance; the angles of the mouth on each side must then be prolonged by a transverse incision, and so dissected up as to form two triangular flaps. Their vertical borders should then be united along the

median line by points of suture; as to the upper border, all that portion of it which exceeds the extent of the intended lip must be attached to the border of the transverse incision which lies opposite to it on either side of the mouth.

"If the operation by the two vertical incisions is adopted, the loss of substance is quadrilateral in shape; to the two incisions which prolong the commissures, two others parallel to these and carried along the base of the lower jaw must be added. By dissection we can thus detach two lateral quadrilateral flaps, which are to be brought together at the median line, and the transverse incisions must be united wherever it may be necessary.

"By this operation, the cheeks alone contribute to form the lip, whose free border is constituted by the raw edge of the transverse incision. The new lip thus formed contains the muscular fibres belonging to the orbicular and its antagonistic muscles; it is covered within by a natural mucous membrane; and even the free border can be covered by this membrane by adopting Dieffenbach's method" (*Manual of Operative Surgery*).

It is rarely necessary to perform the operation of cheiloplasty for the upper lip. Losses of substance in this situation are usually repaired by flaps taken from the cheeks. The indications furnished by the nature and the form of the loss of substance to be repaired will assist in the choice of a method to be adopted.

GENIOPLASTY.

When injuries, attended by loss of substance, which require this operation are small, the edges of the opening may be excised, dissected up and brought together by points of suture. If the loss of substance is of such nature that it cannot be brought together by the above method, a flap may be taken from the cervical region, and brought up on the cheek by the Indian or by the French method. The form, dimensions, and situation of the loss of substance to be supplied will furnish the surgeon with the indications to be fulfilled. In all these cases, the general principles which we have laid down for blepharoplasty and cheiloplasty should be followed.

Plate XLVI.

OPERATIONS UPON THE NOSE AND NASAL FOSSÆ.

RHINOPLASTY.

Rhinoplasty originated in India, where the Brahmins sometimes performed it to restore mutilations which were the result of legal penalties. It was imported into Italy about the fifteenth century, and systematised as a regular operation by Branca and Tagliacozzi. It was performed by Carpue, in England, in 1813, a little later by Græfe, in Germany, and afterwards by Delpech, in France.

The object of the operation is to restore the nose in cases where it has been partially or entirely lost. There are three principal methods recognised at the present day by which this is effected. The operations once in vogue of replacing the lost organ by another perfect nose, or by using the integuments of another person, are no longer performed.

1st. *Indian method.—Ordinary operation* (fig. 1st).—This consists in taking from the forehead of the patient a portion of integuments sufficient to repair the loss of substance. For this purpose, we begin by making a model of wax, or paper, of the nose which is wanting. This model is then turned up on the forehead, so that its base looks upward; its exact shape is traced with ink on the skin of the forehead, and the surgeon makes a section of this skin about two lines beyond the outline which he has thus traced out. The flap is then dissected up to the root of the nose, taking care to leave a pedicle, *d*, large enough for the passage of vessels to nourish it. It is now twisted upon its pedicle, *d*, so that its bleeding surface is turned towards the nasal fossæ, and its edges are joined to the previously pared edges of the cavity of the nose by points of suture. Tents of lint, or two rolls of india rubber *ee*, are then introduced below, to keep the nostrils open, and support the flap. Union being obtained, the points of suture must be removed, the pedicle *d*, cut upon a director, to straighten that portion of it which is twisted, and which usually unites smoothly, if left to itself

Pl. 46.

Fig 1.

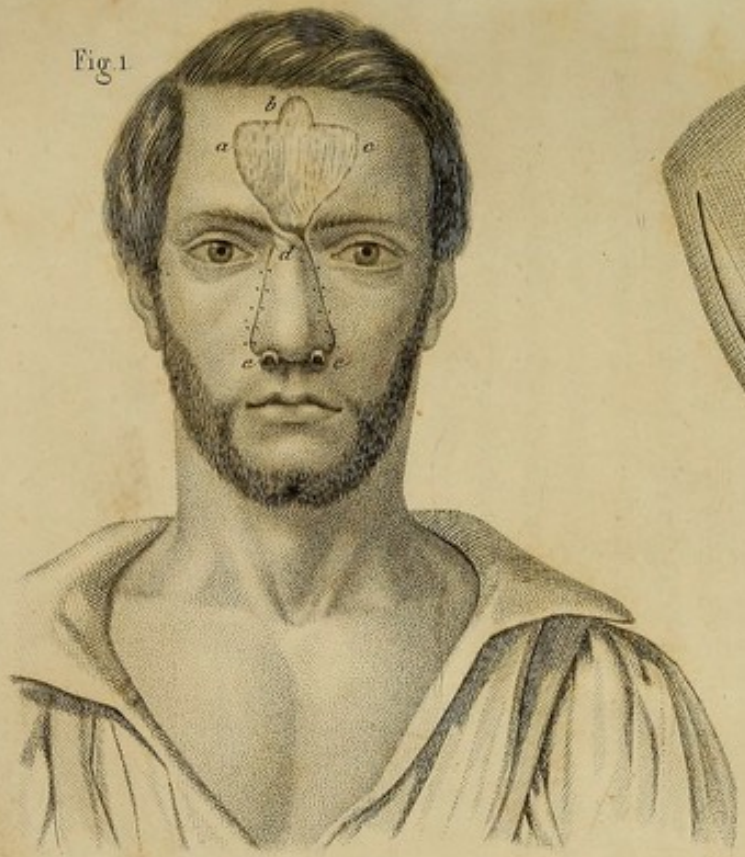




Fig. 2.

The wound of the forehead requires only simple dressings, and cicatrises without difficulty.

Delpech's method.—This consists in cutting the base of the flap as represented in fig. 1, that is to say with three points, *a*, *b* and *c*. The two lateral points are used to form the alæ of the nose, and the middle point *b* the columna.

Lisfranc, to avoid an amount of torsion of the pedicle, which might cause gangrene of the flap, by obstructing the circulation, carried one of his incisions lower than the other, and twisted the flap towards the long incision. But the advantages to be gained by this modification do not always compensate for the inconveniences to which it is exposed by carrying the incisions too near the loss of substance which is to be restored.

Italian method.—Græfe's operation.—This is only a modification of the operation described and performed in Italy by Tagliacozzi. The flap is taken from the skin of the arm, the patient being subjected for some time before the operation, to the fatiguing position which it is necessary for him to retain while cicatrisation is taking place. Fig. 2 represents the bandage to be applied for supporting the arm in a position near the face.

A flap of about five inches in length, and four and a half in width, is marked out upon the arm; it is then dissected up from its point to its base, in such way that those portions intended for the root of the nose and the sides can be immediately fastened in their proper position by points of suture, while the base remains adherent to the arm. Union of the parts thus brought together being obtained, the flesh is divided at its base and separated from the arm. This base may be cut into three points, as has been described above (Delpech's method). Tagliacozzi dissected up the flap and allowed it to suppurate before uniting it to the loss of substance. He thought that the process of suppuration increased the thickness of the flap, and rendered it more fit for the restoration of the nose.

French method.—This consists in filling up the loss of substance by a flap taken from the neighboring parts. It is the method by sliding the flap, already described (see Blepharoplasty, plate 37). The varieties of this method being more appropriate to partial restorations, can be submitted to no general rule. The alæ of the nose may be restored by a flap taken from the cheek; the columna, by a flap taken from the upper lip, care being taken that the mucous membrane is not injured, that only half the thickness of the lip is used, etc., etc.

Summing up.—Rhinoplasty is always an important operation. It rarely effects as much as it promises, and the noses thus made frequently shrink and diminish in size, forming tubercles whose appearance is sometimes more hideous than the original deformity.

At the present time, when the manufacture of noses of wax, or pasteboard, attached to spectacles has reached such great perfection, rhinoplasty is performed only in extreme cases, and the surgeon ought to yield to the solicitations of the patient only after informing him of the dangers and difficulties attendant upon the operation. The Italian method is not well borne by feeble individuals. The Indian method is preferable in the great majority of cases, and Delpech's operation is the best of all.

CONTRACTION AND OCCLUSION OF THE NOSTRILS.

The methods already described for the treatment of occlusions in other parts of the body are also applicable here; to incision or excision, is added dilatation by means of proper canulæ to prevent the cicatrisation from again creating the deformity.

FOREIGN BODIES IN THE NOSTRILS.

There are two passages for the extraction or compulsion of foreign bodies, one in front by the nostrils, the other behind by the pharynx. The size and nature of the body, and the situation which it occupies in the nasal fossæ, will furnish the indications for the method to be adopted for its removal. Pincers or forceps such as are used for the removal of foreign bodies from the external auditory canal may be employed; if the substance is lodged far back, a slight push will usually suffice to force it into the pharynx. In cases where simple means prove inefficient, a dossil of lint may be passed from behind forward through the nasal fossæ, which will draw the foreign body along with it (for the details, see plugging of the nasal fossæ).

POLYPI OF THE NASAL FOSSÆ.

(*See pl.* 47, *Fig.* 1.)

The surgical treatment of polypi of the nostrils depends in a great measure upon their nature, seat and form.

According to their nature, polypi are divided into :—1st, Soft, mu-

cous, or vesicular polypi; 2d, fleshy; 3d, hard, fibrous, or cartilaginous; 4th, fungous or carcinomatous, (malignant).

1st. Mucous, or vesicular polypi are most common, and the least serious in their character; they consist of a greyish substance, slightly vascular, and containing in its vesicles a serous fluid. In general, slightly adherent and frequently pedunculated, these polypi can be easily torn away. They take root in the superior and external walls of the nasal fossæ.

2d. Fleshy polypi are well supplied with blood vessels. They frequently grow to a large size, and push out and deform the parietes which resist their growth.

3d. The hard or fibrous polypi, more rare than the preceding, are formed of a dense tissue, almost completely destitute of vessels. They force the bony walls of the nostrils before them, and frequently cause their absorption. Their pedicles are sometimes exceedingly resistant, and difficult of access.

4th. Under the name of fungous (malignant) polypi, authors have described certain flabby, painful tumours, which bleed readily and profusely, but whose nature is not as yet perfectly settled. Before resorting to an operation the surgeon should endeavour to ascertain, so far as it is possible, the real nature of the polypus. A carcinomatous affection should command the greatest circumspection.

The methods of operating, generally in use, are:—1st, *Cauterization;* 2d, *Torsion;* 3d, *Avulsion;* 4th, *Excision*, and 5th, *Ligature.*

1st. *Cauterization.*—All the varieties of solid and liquid caustics have been employed. Liquid caustics, such as sulphuric acid, acid nitrate of mercury, butter of antimony, etc., should be applied to the polypus with a hair pencil. A small *speculum nasi*, to protect the healthy tissues from the caustic, should be introduced, and the cauterization repeated more or less frequently according to the extent and nature of the disease.

Under the name of *Jensck's caustic*, a mixture of sulphuric acid, butter of antimony and nitrate of silver, has obtained a great reputation in Germany. The nitrate of silver, and the actual cautery have also been successfully employed. The actual cautery is especially suited to mucous polypi, which can be reached through the pharynx. It should not be introduced into the nostrils without a great deal of prudence and dexterity, lest it give rise to an inflammation which might extend to the brain.

2d and 3d. *Torsion, and Avulsion, or tearing away*, are frequently combined. The operation is performed with polypus forceps (see Instruments, plate XII., fig. 1 and 2). Gerdy uses a very strong pair of forceps, whose jaws are armed with teeth, which extend from the pivot to the extremity of the instrument. These forceps resemble very much the forceps used for phimosis (see *phimosis*); with them a large portion of the polypus can be firmly grasped. Curved instruments are employed to seize polypi situated in the posterior nasal fossæ.

The patient being seated opposite a window, with his head thrown back and held by an assistant, the surgeon separates the nostril with one hand, and with the other introduces a pair of closed forceps as far as the polypus. Having reached the tumour, the forceps are opened and carried on until the pedicle is fairly within their jaws. Now the *torsion* commences. The polypus being firmly grasped, the instrument is rotated a number of times. This maneuver frequently suffices to break up the adhesions of the polypus. A peculiar sensation indicates to the surgeon that this result has been effected. Pressing their jaws together, the forceps should then be withdrawn for the purpose of extracting the whole or a portion of the polypus. Occasionally a single operation of this sort completely clears the nasal fossæ; but in the great majority of cases it is necessary to re-introduce the instrument into the nostrils, and again to perform the maneuver, in order to destroy the remains of the tumour which still adhere, and thus, by successive attempts, to completely remove the obstruction. During the operation, a good deal of blood is necessarily lost; a few moment's rest between each attempt should be allowed to the patient.

Some polypi are so soft and slightly adherent that they can be torn away with the fingers; some are pediculated in such a way that a cord carried around the pedicle suffices to bring them away.

Indurated polypi of large size frequently require the use of disarticulating forceps, one branch of which is introduced after the other; in some cases it is necessary to enlarge the opening to facilitate the extraction of the polypus; this is done by dividing the ala of the nose, the upper lip, or even the vault of the palate.

When we operate upon polypi through the posterior nares, curved forceps should be used, and the tumour pushed backward by introducing the little finger into one of the nostrils. Hæmorrhage may follow the operation. Astringent injections, cauterization, etc., usually

stop the flow of blood. But should these means fail, we must have recourse to plugging the nares.

4th. *Excision* is especially applicable to pediculated polypi, situated near the nostrils. Fibrous polypi, with a large pedicle, which cannot be reached with the ligature, may also be excised.

Excision is performed either with the scissors, or the probe pointed bistoury. The polypus being seized with the forceps, should be drawn as near as possible to the opening of the nostrils, and then firmly held until its excision is effected.

Wately removed a large and deep seated polypus by carrying a ligature around its pedicle; one of the ends of this ligature was used as a guide for a sheathed bistoury, which was furnished with an eye near its point, through which the cord was passed. The instrument being carried down to the pedicle, it was then divided. In all cases, the surgeon should select scissors or a bistoury whose shape will permit him to effect the result which he proposes with certainty and facility.

5th. *Ligature.*—The operation by ligature comprises three principal steps, whose object is:—1st, to introduce a loop of silk cord or metallic wire, through the nostrils into the pharynx, or by the pharynx into the nostrils; 2d, to carry this loop around the pedicle which it is intended to strangle; 3d, to constrict the pedicle by means of a knot-tyer.

1st *Stage.*—A pair of forceps properly curved and of the requisite length may be introduced into the nostril and carried backward into the pharynx; at this point, the two ends of a ligature, introduced by the mouth, should be placed in the jaws of the forceps, which then draw them out through the nostril (Ledran).

An eyed probe armed with a ligature, may be carried through the nostril into the pharynx, where the cord can be caught either with the forceps, or the fingers.

Belloc's sound (see Instruments, plate X., fig. 15), for certainty and convenience is more to be depended upon than the preceding. The operation is performed with this instrument in the same way as for plugging the nares (described above).

2d *Stage.*—The loop of thread should be carried around the pedicle of the polypus in such a manner that it will not slip. It may be arranged either with the fingers, or by means of instruments made for the purpose, called ligature carriers, which are so constructed that the surgeon can give the loop the proper size while carrying it around

the pedicle (see Instruments, plate XII., figs. 3 and 4, for the ligature carriers, invented by Felix Hutin and that of Charriere).

3d *Stage.*—The loop being placed in its proper position, and the pedicle fairly embraced, the surgeon takes hold of the ends of the ligature and draws out the ligature carriers, in order to use the knot-tyer. A glance at figures 5, 6, 7 and 8, of plate XII., will give an idea of these instruments and their modes of action. Mayor's knot-tyer, which resembles a string of beads, is flexible, and adapts itself to the windings of the cavities into which it is introduced. The ligature should be tightened daily, until the polypus drops off; this usually happens within the week.

PLUGGING OF THE NASAL FOSSÆ.

This operation ought only to be performed to arrest a hæmorrhage, which resists the ordinary method of treatment. Cold or astringent injections, cold affusions to the head and back, foot and hand baths, elevation of the arms, should all be previously tried. If the hæmorrhage still persists, we should have recourse to plugging. By this operation, a direct compression is not exercised upon the point from whence the blood flows, but its escape both before and behind is prevented, and a clot is formed in the nasal fossæ, by the pressure of which the hæmorrhage is arrested.

Franck's method.—A piece of a pig's intestine which has been dried in the air is employed here. After softening it, one of the extremities is tied and introduced into the nasal fossæ by means of a sound; water is then injected into the bag thus formed, and the end, outside of the nostril, firmly secured.

Martin St. Ange uses an instrument similar to that of Franck, to which he gives the name of Rhinobyon. It consists of a small bladder fastened to a silver canula, which is furnished with a stop-cock; this bladder is introduced into the posterior nasal opening, it is then filled with air, and the stop-cock closed. The dilated bladder acts as a plug in the pharynx; a roll of lint placed in the nostril in front completes the occlusion, and a small pair of forceps sliding upon the canula, fastens the apparatus to the alæ of the nose.

Martin Solon has simplified this last method. Instead of a silver canula he uses a gum-elastic catheter. A double thread attached to the end of the catheter, where the bladder is fastened, hangs out of the nostrils and can be used to fasten the roll of lint

after the bladder has been distended with air. A simple stopper in the catheter prevents the escape of the air.

Ordinary method.—A roll of lint to stop the posterior opening of the nasal fossa is made, and to this a very strong silk thread is tied, whose extremities are long enough to reach from behind forward, through the nostril. Belloc's sound (see plate X., fig. 15), or a very flexible gum-elastic catheter, is introduced by the nostril; when the extremity of the instrument is in the pharynx, the button of Belloc's sound is sprung, or if the gum-elastic catheter is used, its end is drawn out through the mouth; to this end the threads of the plug *c* are attached, and by withdrawing the catheter they are brought from behind forward through the nostril; by pulling upon the thread the plug is introduced into the posterior nasal opening, which it stops as completely as possible. A second plug slid between the two threads should be tied into the nostril in front. The nasal fossæ being thus tamponned, both in front and behind, the apparatus should be allowed to remain for two or three days. To withdraw the plugs, the thread in front of the nostrils must be cut; the posterior plug can be seized through the mouth by a pair of forceps, or pushed backward into the pharynx, by means of a catheter carried through the nostrils.*

* It is more surgical to attach a ligature to the posterior plug, before its introduction, which is brought out at the mouth and attached temporarily in front; by drawing on this the posterior plug can be more readily removed. Without this precaution the withdrawal of the posterior plug is sometimes a troublesome and very painful process. Sponge is a good substitute for lint, as a material for the plugs.—Ed.

OPERATIONS UPON THE FRONTAL AND MAXILLARY SINUSES.

PERFORATION OF THE FRONTAL SINUS.

The diseases which require trepanning of the frontal sinus are: fractures, caries, necrosis, abscess, the presence of foreign bodies, polypi, etc. A semi-lunar incision, with its concavity looking upwards and inwards, is made on a line with the commencement of the eyebrow; the flap being turned up, the crown of a small trepan is applied. This is always an important operation, and to cure the fistula which frequently follows it, recourse must be had to compression (which often fails), or to autoplasty.

CATHETERISM AND PERFORATION OF THE MAXILLARY SINUS.

Catheterism.—The entrance to the maxillary sinus is situated above the inferior turbinated bone *a* (see plate 43, fig. 1), and below the middle turbinated bone *b*; to reach it, a small curved sound must be introduced beneath the middle turbinated bone. About the middle of this bone the point of the sound will encounter an opening, into which it can be inserted.

Jourdain has employed emollient injections successfully, in a case of retained mucus. If the orifice of the sinus cannot be found, or if it is obstructed, an artificial opening can be made with a small curved trochar, by perforating from within outward the bony walls of the sinus beneath the turbinated bone.

Perforation of the parietes of the sinus is the plan of treatment generally adopted at the present day, and there is more than one method of performing the operation. *Lamorie* perforated the sinus from the outside, between the zygomatic process and the third molar tooth. *Desault* made his opening through the canine fossæ after first incising the skin of the cheek. Desault's method has been modified; an incision of the gums is made, and the perforation effected half an inch or more above its border. The wound leaves no visible cicatrix.

Cheselden opened the sinus through the mouth. All these methods have their advantages and their disadvantages; peculiar cases may require their application, but the following operation is the one generally preferred.

Ordinary method.—This method, which is attributed to Meibomius, leaves no visible cicatrix, and consists in perforating the alveoli and thus reaching the maxillary sinus through its floor; the opening is thus dependent, and is easily accessible to instruments.

All of the molar teeth correspond to the sinus, and through one of their sockets the opening should be made. If one of the teeth is wanting, the operation should be performed through its socket; if a molar tooth is carious, it should be extracted in preference, whichever it may be (Malgaigne). If all the molar teeth are sound, the second should be extracted, and the perforation made through its socket.

The operation may be performed with a punch, a trochar, or a small perforating trephine. The nature of the affection requiring the operation should indicate the dimensions of the opening. Belloc introduced a wooden stopper into the artificial orifice to prevent the food from finding its way into the sinus. Other surgeons have recommended the introduction of a permanent canula.

It is very difficult to appreciate theoretically the relative value of these methods; but perforation of the alveoli is in general easy, and besides appears to be indicated by nature herself, since in certain cases liquids contained in the sinus frequently escape through the socket of a tooth which has been lost.*

* The operator should be provided with several drills gradually increasing in size, which should be successively introduced by a boring motion. The opening should be large and free, otherwise it will become clogged up.—Ed.

Plate XLVII.

LIGATURE OF A POLYPUS OF THE NASAL FOSSÆ; REMOVAL OF THE TONSILS.

Fig. 1. Antero-posterior vertical section of the face; *a*, loop of thread carried around a polypus of the nasal fossæ by Charriere's ligature holder, *b* (Instruments, plate XII., fig. 4).

Fig. 2. Anatomical arrangement of the tonsils between the pillars of the velum palati; *a*, the tongue; *c b*, the tonsils.

Fig. 3. A tonsil seized with the hooked forceps *a*, is being excised with a probe pointed bistoury *b*, around a portion of whose blade a piece of linen is wound.

Fig. 4. *a*, a tonsil being excised by means of the tonsil instrument *b* (Instruments, plate XIII, fig. 1 and 2, 3 and 4).

Pl. 47.

Fig 1.

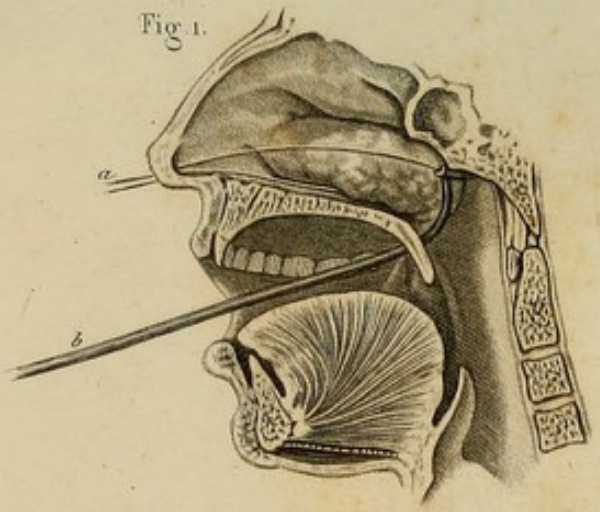


Fig 2.

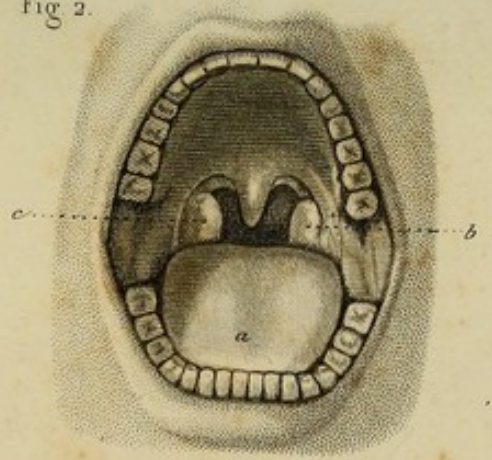


Fig 3.

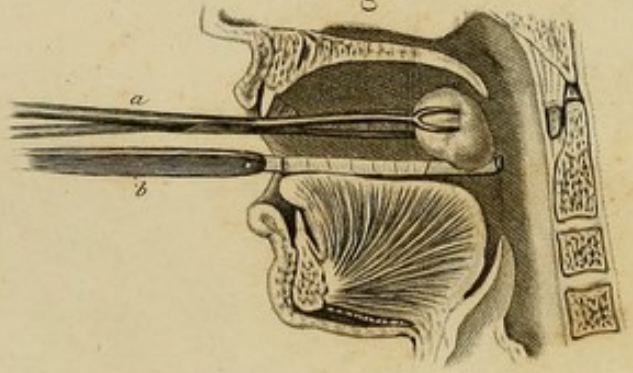
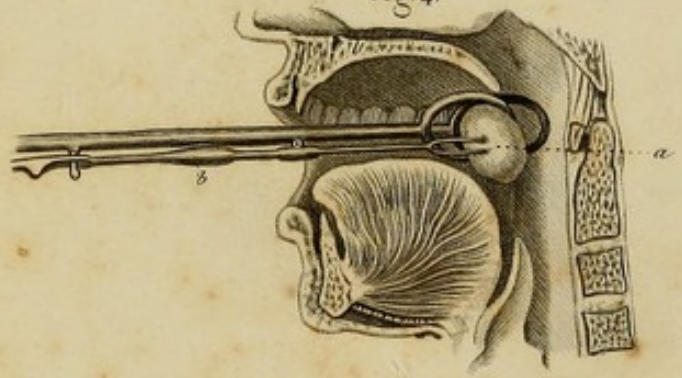


Fig 4.



Pl. 48.

Fig. 1.

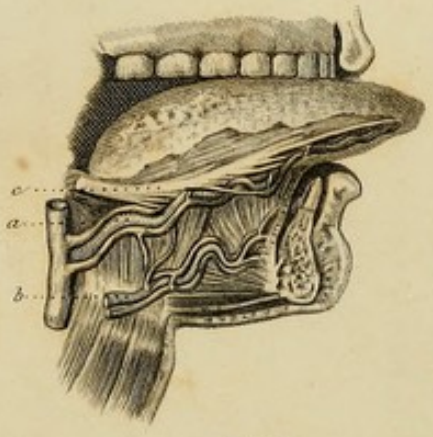


Fig. 2.

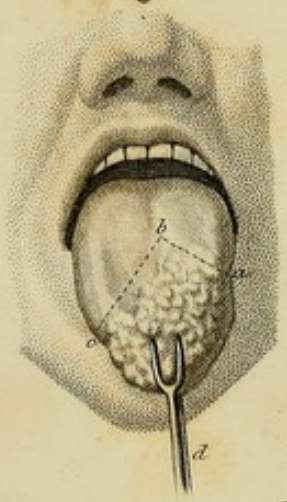


Fig 3.

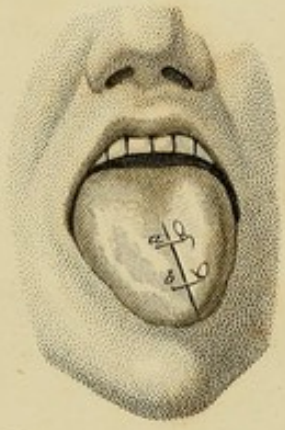


Fig 4.

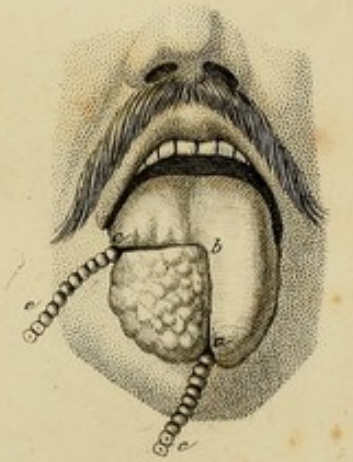


Fig 5.

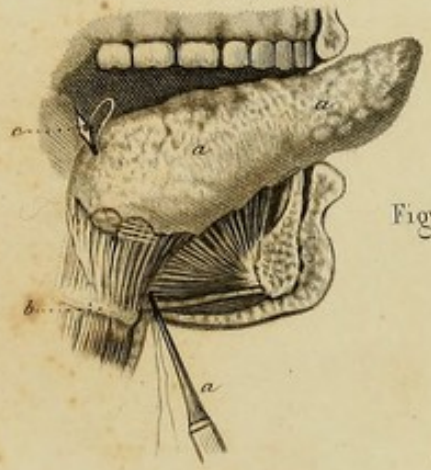


Fig 6.

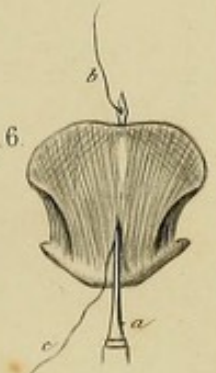


Fig 8.

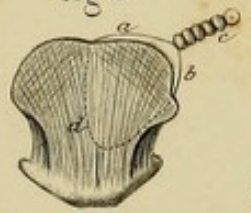


Fig 7.

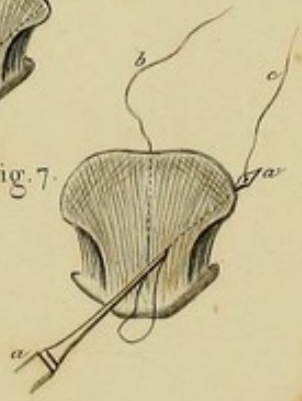


Fig 9.

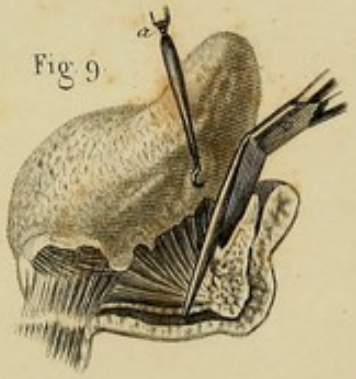


Plate XLVIII.

CANCER OF THE TONGUE, AND THE OPERATION FOR STAMMERING.

Fig. 1. *Surgical anatomy.*—This represents the course of the lingual arteries *a* and *b*; *c*, the hypoglossal nerve. Farther on we shall show the muscles of the tongue.

Fig. 2. The cancerous portion is seized with the hooked forceps *d*; two incisions *ab* and *cb*, united at the median line forming a V, make a triangular wound, whose edges are afterwards brought together by points of suture; fig. 3, *a* and *b*.

Fig. 3. *Union after the operation.*

Fig. 4. The cancerous portion is comprised between two ligatures *bc* and *ba*, which are tightened by means of two knot-tyers in the form of a string of beads, *e e*.

Fig. 5. *Method of Vidal.*—A straight needle *a*, attached to a handle, is introduced just above the os hyoides *b*, and passed through the tongue from below upward; *c*, a loop of thread introduced into the eye of the needle.

Fig. 6, 7 and 8. *The same method.*—Transverse section of the tongue, showing the course which the needle should take.

Fig. 6. *a*, the needle, *b*, an end of thread disengaged; the other end *c* is hanging down on the outside.

Fig. 7. The needle *aa*, has been withdrawn and thrust laterally through the tongue, so that its point appears along the border of the diseased organ; the ends *bc* of the thread are disengaged.

Fig. 8. *a* and *b* show the ends of the thread, whose loop *d* embraces the lateral half of the tongue, brought together by a knot-tyer *c*.

Fig. 9. *Section of the genio-glossi muscles after the method of Baudens.*—A hook *a* is buried in the mucous membrane; the section of the genio-glossi muscles is being effected by means of scissors very much bent on their flat surface.

CANCER OF THE TONGUE.

MODES OF OPERATING.

Before undertaking any of the operations involving the loss of a portion of the substance of the tongue, the surgeon should not forget that some tumours are entirely superficial, and that in such cases it is only necessary to remove a thin layer of the tongue to isolate them from the sound parts; that others are encysted, being seated within the substance of the organ, and can be easily extracted by enucleation. But some diseases require *excision*, or the *ligature*.

Excision.—Excision always involves a certain amount of the sound tissues of the organ, proportionate to the extent of the disease, generally a line or more beyond the limits of the tumour. Corks, inserted between the teeth, are used to keep the mouth open; the tongue should be caught with hooked forceps and drawn as far as possible out of the mouth; the section should be made either with a bistoury, or with scissors—straight, oblique, or curved, according to the form and situation of the cancer. If the removal of the diseased portion cannot be effected with a single cut, the operation should be commenced upon the inferior aspect of the organ so as to prevent the flow of blood from obscuring the second incision.

Boyer included the tumour in a V shaped incision (fig. 2, *cb* and *ba*). The wound was afterward brought together by two or three points of suture (fig. 3).

Ligature.—Mayor's method.—The disease is isolated from the sound parts, by means of ligatures carried through the entire thickness of the organ. For a cancer which occupied only half of the tongue, Mayor transfixed the organ near its base with a bistoury, and incised it from behind forward through its entire thickness. The diseased portion was then embraced by a ligature which was tightened by means of Mayor's knot-tyer (Instruments, plate XII., fig. 7). The disease may also be embraced between two ligatures (fig. 4), without having recourse to incision.

Method of J. Cloquet.—In the case of a cancer which had attacked

the entire lateral half of the tongue and advanced towards its base so far as to prevent the application of the ligature by the mouth, Cloquet performed the following operation :—

A curved needle, fixed in a handle, with an eye near its point, was introduced along the median line of the neck, above the os hyoides, and carried upwards entirely through the tongue. The eye of the needle being brought out near the front teeth by carrying its handle backwards, two ligatures were passed through it. The surgeon then withdrawing the needle, brought the ligatures out through the wound in the neck, thus leaving one end of the double ligature in the mouth, and the other hanging in front of the neck below. The needle was then introduced anew into the wound in the neck, and brought out upon one of the sides of the tongue, its eye now threaded with the ends of the ligature already in the mouth, and again withdrawn, brought out these through the original wound in the neck. These two ligatures answered the following purpose : One of them embraced transversely the half of the tongue, and the other, being caught in a small incision made in the tip of the organ, included in an antero-posterior direction all that portion which was cancerous.

Method of Mirault, of Angers.—This is only a modification of the preceding. The needle is passed through the tongue from below upward, and being brought out of the mouth, is again thrust through from above downwards along one of the sides of the organ.

Method of Vidal.—(Figs. 5, 6, 7 and 8). We borrow from the author the following description of his operation :—"I use a large straight needle inserted into a handle (fig. 5, *a*). Its point is lance-shaped, and near the extremity is an eye. If but one half of the tongue is to be ligated, a very strong single ligature is inserted into the eye. After seizing the tongue by its apex and drawing it as far forward as possible, the needle should be thrust in just above the os hyoides *b*. The more the disease has extended towards the base of the tongue, the farther back should the point of the needle be carried. After passing through the tongue from below upward, the point of the instrument appears in the mouth with the loop of the ligature in its eye ; the two ends of the cord hang in front of the neck, and are held by an assistant. The surgeon holding the handle of the needle with one hand, with a pair of dissecting forceps in the other, catches one end of the ligature in the mouth, and drawing it out through this cavity gives it to another assistant (fig. 6, *b*) ; one thread

c still remains in front of the neck. The surgeon then carries the needle *a* downwards, as if about to withdraw it; but having brought the point below the tongue, he thrusts it again upwards and outwards until it appears upon one side between the anterior pillar of the velum palati and the border of the tongue (fig. 7). The end of the ligature which hangs in front of the neck is then drawn out of the eye of the needle with the forceps. The instrument being free, is withdrawn. The ends of the thread *a b* (fig. 8) are now tied in the mouth, or are carried through a knot-tyer *c*. If the whole of the tongue is cancerous, a double ligature may be introduced which will embrace both portions of the tongue. For this purpose two ligatures should be introduced into the eye of the needle; one of which should be black, and the other white. This difference in color facilitates the ligature of the same side of the organ with the same thread.

OPERATIONS FOR STAMMERING.

Works upon operative surgery describe a great number of methods by which surgeons have attempted to remedy stammering. Now that experience has sufficiently demonstrated the inutility and danger of the greater part of the operations which have been undertaken for this purpose, we shall limit ourselves to the description of those methods which offer some chance of success, and which, from their simplicity, are by no means dangerous.

Baudens' method.—Section of the genio-hyo-glossi muscles (fig. 9).—The patient is seated upon a chair, with his head held by an assistant who at the same time draws back the commissures of the lips; the surgeon, with a hook in the left hand, raises the mucous membrane above the border of the genio-hyo-glossi muscles, and thrusting a pair of half open pointed scissors, bent upon their flat surface, to the depth of about an inch, and as closely as possible to the lower jaw, divides with a single cut the attachments of these two muscles. A small piece of sponge or lint is then placed in the wound and allowed to remain until the hæmorrhage ceases. The wound rapidly heals.

Method of Bonnet.—Subcutaneous section of the genio-hyo-glossi.—The patient being seated with his head thrown back, the surgeon introduces the index finger of the left hand into the mouth, as far down as the tubercles on the inner surface of the jaw; then, with the right hand he thrusts a sharp pointed tenotomy knife, beneath the chin and

along the median line, through the skin, the platysma and the space between the digastric and the mylo-hyoid muscles; this instrument is then replaced by the blunt-pointed tenotomy knife, which is carried into the wound, with its edge forward, until the point of the instrument is felt by the finger in the mouth—when the surgeon gives a lateral direction to the cutting edge of the knife, and with it divides one after the other the genio-hyo-glossi muscles. Before this part of the operation is performed, the surgeon should assure himself that the knife is fairly between the tubercles, and that it is not caught in the mucous membrane. After the operation, an extravasation of blood, more or less in quantity, may take place, which slightly embarrasses deglutition during two or three days.

The various operations for stammering have so frequently proved to be ineffectual, that we are forced to have recourse to persevering discipline of the organ, which has been reduced to a system by Colombat (de l'Isere), Serres (d'Alais), and other physicians, who have obtained by its use undoubted success.

DIVISION OF THE FRÆNUM.

The frænum, when it is prolonged too far towards the tip of the tongue, interferes with suction in the newly-born child, and still later in life prevents distinct articulation. It should not be forgotten that the ranine veins are situated on the under surface of the tongue, on either side of the frænum. The child must be placed upon the knees of an assistant, who should hold the head back and pinch the nose to force the child to open its mouth; the surgeon should raise the tongue with the thumb and index finger of the left hand, to put the frænum on the stretch, and having in his right a pair of scissors curved upon their flat surface, with them he divides it with a single cut, as far as possible from the tongue, by directing the point of the scissors downwards, to avoid wounding the ranine veins.

The slit handle of a director may be used to raise up the tongue, by introducing the frænum into the opening. The wound requires no special treatment.

Two accidents may follow this operation; 1st, retroversion of the tongue into the pharynx, an accident which might cause suffocation, as J. L. Petit remarks; 2d, hæmorrhage, when the ranine veins are wounded. In the first, the index finger easily brings the tongue

forward into its proper position, and in the second, astringents may be used, or cauterization performed with a steel probe heated to a white heat. Malgaigne recommends the closing of the wound in the vein with a point of interrupted suture.

We sometimes observe in newly-born children sublingual tumours which appear in the shape of very firm fleshy excrescences. These tumours should be seized with the forceps, and excised with curved scissors.

ABNORMAL ADHESIONS OF THE TONGUE.

These adhesions may be congenital, or recent. In the first case, they are mere cellular bridles, which are easily divided with the scissors; in the second, they are frequently the result of inflammation, have more extensive connections, and are sometimes exceedingly resistant.

The patient should be seated in a chair, with the head thrown very far back and the mouth kept open by means of a cork placed between the molar teeth; the surgeon, standing behind the patient, should separate the cheek and the free portions of the tongue, and then with a bistoury held obliquely with its cutting edge looking outwards, divide the adhesions. The operation should be suspended from time to time to allow the patient to use astringent gargles.

The wound heals of itself. To prevent new adhesions, the patient should be advised to move his tongue frequently and to slip a finger between the divided surfaces.

EXCISION OF THE UVULA.

The patient being seated in a chair and held in the same position as for excision of the tonsils, the surgeon seizes the uvula with polypus or torsion forceps, and excises it with a simple cut of the scissors or a bistoury. The hæmorrhage is usually slight, and may be arrested by squeezing the remaining portion of the uvula between the jaws of the forceps, or touching the bleeding surface with the nitrate of silver.

OPERATIONS UPON THE TONSILS.

ABSCESS OF THE TONSILS.

When tonsilitis terminates by suppuration, a purulent collection results, which must be evacuated. To effect this, the index finger of one hand should be carried down as far as the tonsil, and along this finger should be slid a sharp-pointed bistoury, whose blade is wound with adhesive plaster to within a third of an inch of its point. The pus is evacuated by making an incision at the point where fluctuation is felt.

EXCISION OF THE TONSILS.

(*Plate* 47.)

Chronic inflammations of the tonsils frequently cause hypertrophy of these glands which embarrasses deglutition and respiration. Scarification, cauterization and the ligature have all been employed at different epochs for this affection. At the present day excision is generally adopted. It may be performed with the hooked forceps of Museux and a probe-pointed bistoury, or with some one of the various tonsil instruments invented for the operation.

Operation.—The patient should be seated opposite the light, with his head resting upon the chest of an assistant who keeps the jaws separate by means of wedge-shaped cork placed between the teeth; the same assistant may, if necessary, stand in front of the patient, and depress his tongue with a spatula, or the handle of a spoon. The surgeon standing in front, seizes the tonsil with Museux's forceps and brings it out between the pillars of the arch of the palate, by pulling it slightly forward, which places the gland in a more prominent position and a greater distance from the carotid artery; then, with its back downwards, the surgeon introduces a probe-pointed bistoury whose blade is wound with linen to within an inch and a half of its extremity, and carrying it beneath the tonsil, excises the gland with a sawing motion from below upward, and parallel with the margins

of the pillars of the fauces; the portion excised is withdrawn with the forceps. As a general rule, as much as possible of the tumour should be removed. This operation is rarely followed by much hæmorrhage, and astringent gargles, or powdered alum applied to the bleeding surface by means of a brush, usually suffice to arrest the flow of blood. Occasionally the hæmorrhage is considerable; in such cases the surgeon should resort to the actual cautery for its arrest. Full respirations have also been advised to stop the flow of blood. Should the carotid artery unfortunately be wounded, immediate compression must be made with the fingers upon the primitive carotid; compression should also be made at the same time upon the point from whence the blood issues, by means of a piece of lint fastened to one of the jaws of a straight pair of Museux's forceps; this one branch of the forceps should alone be introduced into the mouth and the plug of lint applied between the pillars of the arch of the palate, the check being used as a point of support for the other branch; a piece of cord passed through the handles and tied, fastens the forceps in this position, and thus a temporary compression will be obtained, sufficient in some cases to arrest a slight hæmorrhage, and always useful if the operation of tying the carotid is performed.

We cannot undertake the description of the various instruments invented for the excision of the tonsils. (Instruments, plate XIII.) Fig. 2 represents Fahnestock's instrument, modified by Velpeau. The tonsil is caught between its two rings; a sliding spear, either single or double (fig. 3), or a revolving hook (fig. 4), fastens the tonsil and causes it to project between the rings by a lever-like motion, which lifts out the tonsil to a certain distance from the plane of the rings; the tonsil being thus fixed, its section is effected by sliding one of the rings upon the other *a* (plate 47, fig. 4).

These instruments, many of which are very ingenious, may be advantageously employed to operate upon children, but they are not applicable to all cases, and frequently effect only an incomplete section of the diseased gland. Thus the preference is generally given to the bistoury, for performing this operation (plate 47, fig. 3, *a*, *b*).

Pl. 49.

Fig. 1.



Fig. 2.

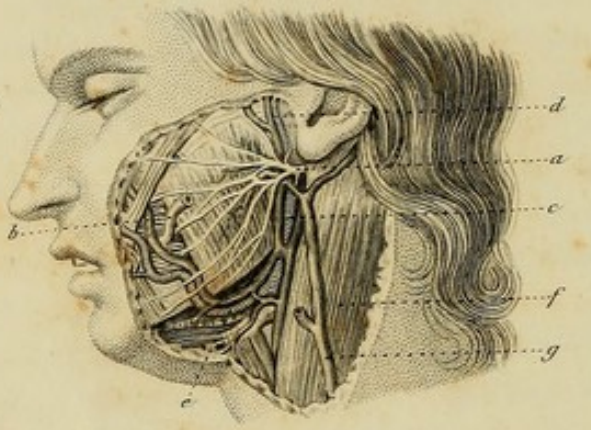


Fig. 3.



Fig. 4.

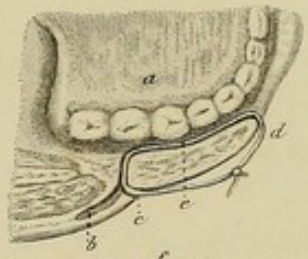


Fig. 5.

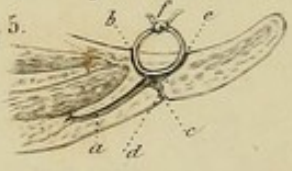


Plate XLIX.

OPERATIONS UPON THE SALIVARY APPARATUS.

FISTULA OF THE PAROTID AND STENO'S DUCT.

SURGICAL ANATOMY.

Fig. 1. *The parotid gland*, *a*, which is almost pyramidal in shape, is bounded above by the zygomatic process and the temporo-maxillary articulation; behind, it rests upon the *sterno mastoid-muscle;* it corresponds with the mastoid process and the digastric muscle, and winds from without inwards around the ramus of the lower jaw bone, sending prolongations beneath its angle. The external carotid artery and the facial nerve pass through its deep or reflected portion. The relations of these organs with the gland, we shall notice farther on.

In front, the parotid gland is thin; it spreads itself upon the external surface of the masseter muscle by irregular prolongations, whose inner aspect is in relation with the transverse facial artery, and some branches of the facial nerve. Its superficial surface is also in relation with some lymphatic glands, which are occasionally lodged in its substance, but which are more frequently situated in the meshes of the fascia, which forms a sheath to the gland. These ganglia may be the seat of morbid affections or of abscesses, and the gland itself remain perfectly healthy.

Fig. 2. The deep relations of the parotid are of great surgical importance. In this plate the gland has been dissected up and removed so as to show the nerves and blood-vessels which wind along in its substance.

The *facial nerve*, *a*, is embedded in the substance of the gland and here divides into branches, the principal of which take a direction nearly horizontal, which should not be forgotten when opening abscesses in this region. Incisions made at right angles with the course of the nerve, frequently cause paralysis of the face, by cutting some of its larger branches.

The *external carotid artery*, *c*, passes almost always from below

upwards through the deep portion of the gland. The *temporal artery*, *d*, the transverse facial artery and important venous branches, pass through the gland in diverse directions.

Are not these relations sufficient to indicate the difficulties and dangers attending the extirpation of this gland?

Steno's duct, *b* (fig. 1 and 2), takes a horizontal direction from behind forward, upon the masseter muscle, in the course of a line drawn from the lower part of the ear to the commissure of the lips; on a level with the anterior border of the masseter, the duct changes its direction and takes a perpendicular course in the substance of the cheek, perforates the buccinator, and, after passing obliquely for a short distance between this muscle and the mucous membrane of the mouth, opens into its cavity on a level with the space which separates the first and second molar teeth. This duct is accompanied in its course by some branches of the transverse facial artery, and also by a branch of the facial nerve.

The *sub-maxillary gland*, *c* (fig. 1), is situated beneath the body of the lower jaw, and corresponds with the maxillary fossa, in which it is lodged; below, this gland is covered by the cervical aponeurosis and the platysma myoides; within, it has relations with the digastric, mylo-hyoid and hyo-glossus muscles and the lingual nerve. Its most important relation is with the *facial artery*, *d* (fig. 1), which passes through it in a direction upwards and inwards. *Wharton's duct* takes its origin in this gland and opens into the mouth upon one side of the frænum linguæ.

Fig. 3. *Morand's method.* (See modes of operating.)

Fig. 4. This represents a horizontal section of fig. 3. *a*, superior dental arch; *b*, Steno's duct; *c*, fistulous opening; *e*, a seton tied externally upon the cheek; *d*, commissure of the lips.

Fig. 5. *Method of Deguise.* (See modes of operating.)

MODES OF OPERATING.

There are two classes of salivary fistulæ; one of them affects the parotid gland directly, and is seated either in the gland itself, or in one of the roots of the salivary duct; the other is produced by lesions of Steno's duct.

§ 1. *Parotid fistulæ* may be cured by different means.

1st. *Irritating injections*, recommended by Louis, consisting of astringent, or more or less escharotic liquids.

2d. *Cauterization*, by means of caustics, or the actual cautery.

3d. *Blisters*, applied upon the fistula itself have been employed successfully by Velpeau.

4th. *Compression*, proposed by Desault for the purpose of producing atrophy of the gland; the more methodical *compression* proposed by Malgaigne, who applies a piece of gold leaf covered with Burgundy pitch upon the fistulous opening, in order to favour cicatrization by preventing mechanically the passage of the saliva.

5th. *Excision*, which consists in circumscribing the ulcer by two elliptical incisions, and then uniting their edges by suture.

6th. *Extirpation* of the parotid gland is now rejected as an extreme and dangerous resource, and only to be adopted in cases of absolute necessity.

§ 2. *Fistulæ of Steno's duct* may be treated by a great variety of operations, classed under four heads, whose object is: 1st, cicatrization of the fistulous orifice; 2d, dilatation of the natural duct; 3d, establishment of a new orifice in the mouth; 4th, atrophy of the gland.

1st. *Mode of cure.—Compression* either upon the fistulous orifice, or upon a portion of Steno's duct, between the fistula and the gland, may favour cicatrization of the wound by preventing the flow of saliva through the fistula. This mode of treatment is indicated in cases where the orifice of the duct in the mouth is entirely free, and when the fistula is susceptible of rapid cicatrization.

(2d). *Cauterization* may also be employed in these cases as well as for fistulæ of the parotid gland.

(3d). The *twisted suture* may also be successfully used; if the fistula is of long standing its edges should first be pared off.

2d. *Mode of cure.—Re-establishment of the natural duct.—Morand's method* (fig. 3 and 4).—A seton is introduced by means of a small probe into the orifice in the mouth and brought out by the fistulous opening, or rather, is introduced into the fistulous opening and brought out through the orifice in the mouth. The obstructions to the passage of the saliva through the duct being removed, the seton should be withdrawn, with the exception of one of its extremities, which may be left in the duct. The edges of the fistula should then be pared off and cicatrization promoted by the ordinary means.

3d. *Mode of cure.*—This consists in making an artificial canal.

For this purpose, Deroy carried a red hot iron through the substance of the cheek in front of the masseter muscle, a method which has been modified by most operators since Deroy. At the present time, the method of Deguise is generally adopted.

Method of Deguise (fig. 5).—The figure represents a horizontal section of the cheek which shows the arrangement of the parts; *a*, Steno's duct and *c* the fistulous orifice. A small trochar is passed to the bottom of the fistula and as much as possible into Steno's duct, and carried through the cheek from without inwards and from before backwards in the direction *c b*. Two fingers introduced into the mouth support the cheek and the point of exit for the instrument. The trochar being withdrawn, and the canula left in the wound, a leaden wire *c b* is carried through the tube, when the canula is withdrawn. The trochar is now thrust in a second time in the direction *d e*, opposite the first. A silk thread *d e*, being passed through the canula, it is withdrawn. The silk thread is tied to the extremity *c*, of the lead wire, which is drawn by it into the mouth along the line *d e*, where the two ends of the wire are united to form a ring *f*, which embraces the soft parts at the bottom of the fistula. The edges of the fistula are then pared off and brought together by a point of suture. Cicatrization being effected, the wire is cut and the saliva takes its course through the artificial opening.

The method of Deguise has undergone some modification. Roux uses a silk thread instead of the lead wire, etc. Malgaigne employs a very strong silk thread with a needle at each of its ends. The first needle is thrust into the cheek along the line *c b;* the second in the direction of the line *d e*. The two extremities of this thread being tied in the mouth, the soft parts are embraced in the same way as by the leaden ring. This operation is as quick as it is easy of execution.

4th. *Mode of cure.*—Desault recommended compression to produce atrophy of the parotid gland. Viborg, proposes the ligature of Steno's duct for the same purpose. But experience has not as yet sanctioned these recommendations, and the operations described under the third mode of cure seem to us decidedly preferable.

EXTIRPATION OF THE SUB-MAXILLARY GLAND.

For anatomical details, see the explanation of plate 49.

Operation.—A crucial or semilunar incision of the skin should be made over the gland, and the vessels tied and cut between two ligatures. The gland, being seized with a hook, must be drawn out and isolated from the hypoglossal nerve and the lingual artery by careful dissection; a ligature should then be applied above the place where the gland is to be finally severed from its connections. After the operation, immediate union may be attempted, if the wound will permit it, or it may be filled with lint, and united by the second intention.

RANULA.

Ranula is a name given to tumours developed laterally beneath the tongue, and situated between this organ and the lower jaw, above the supra-hyoid muscles. These tumours, upon whose nature surgeons do not always agree, originate in the sub-lingual gland, or are produced by a dilatation of Wharton's duct. Jobert has described salivary encysted tumours in Wharton's duct. Whatever their character may be, these tumours, sometimes, from their size, render deglutition difficult, project externally, and require a surgical operation for their cure.

Puncture and *incision* employed in ancient times, are now rejected as inefficacious.

Cauterization by the red hot iron was employed by Ambrose Paré; but, at the present time, cauterization by means of liquid escharotics is preferred. Injections of iodine have been used with success.

The *seton* has been used to create an adhesive inflammation of the parietes of the cyst. The *canula*, first applied by Lecat, was again taken up and modified by Dupuytren, who through an incision made in the tumour introduced a double-headed canula which was to be permanently retained; through this tube, the saliva, or the liquids secreted by the cyst could always find exit. This method is frequently successful.

Excision is now generally adopted. To effect it, the upper wall of the tumour is raised up with a hook or the forceps, and excised with a pair of scissors or the bistoury; the tumour empties itself, and cicatrization rapidly takes place.

Of all the operations for ranula, excision is the quickest and the most simple. Cauterization with the nitrate of silver, joined to excision (Malgaigne), is still more certain of success.

Jobert, under the name of *batra-chosioplasty*, has described an operation which is only a modification of the preceding. The flaps resulting from a longitudinal incision of the tumour are turned back and fastened to the mucous membrane of the mouth by points of suture. This operation is both difficult and tedious.

PI. 50.

Fig. 1.

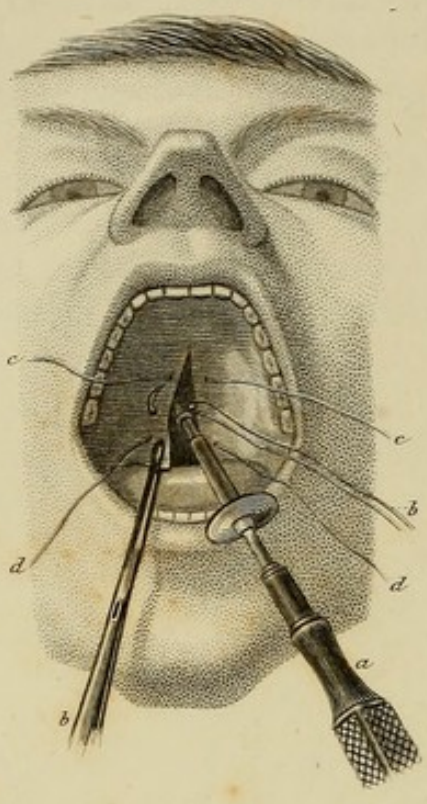


Fig. 2.

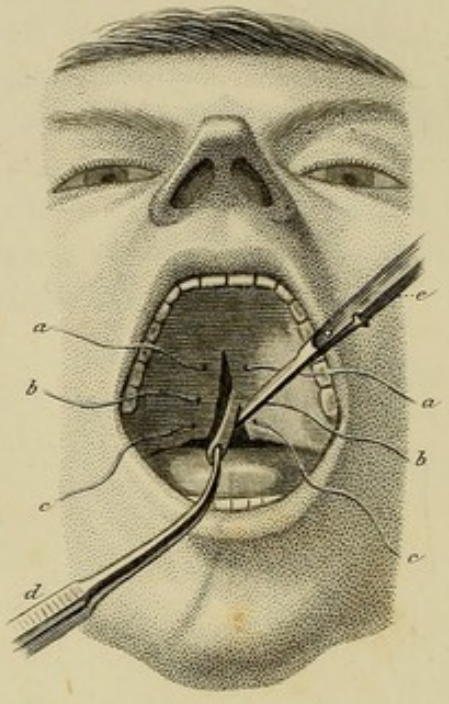


Fig. 3.

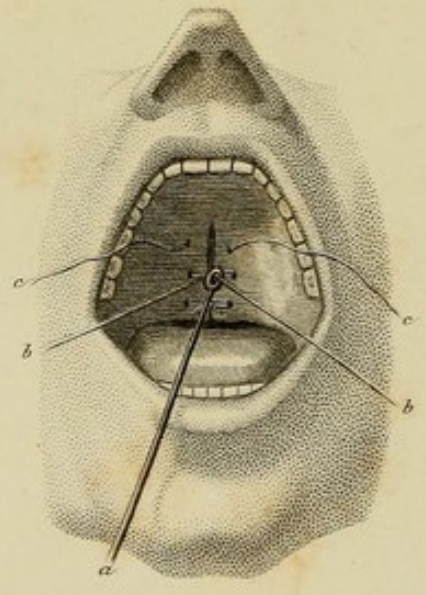


Fig. 4.

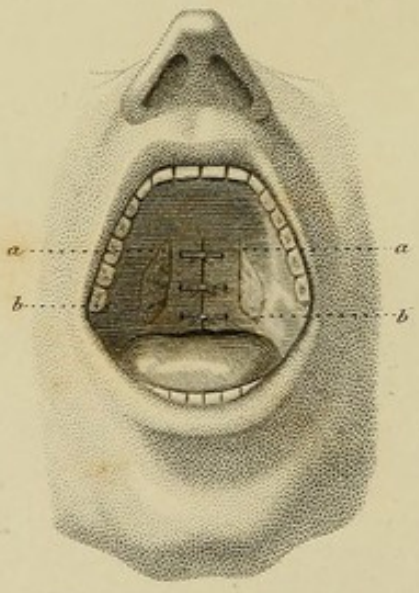


Plate L.

STAPHYLORAPHY.

Fig. 1. *Roux's method.*—The first and second ligatures, *dd* and *cc*, being in their proper position, the surgeon is placing the third in the middle between them. One of the flaps is held with the forceps *b*, and the needle, attached to its holder *a*, is being carried through its margin from behind forward.

Fig. 2. The three ligatures *aa*, *bb*, and *cc*, being placed in their proper position, the surgeon is paring off the edges of the flaps with a probe-pointed bistoury.

Fig. 3. Tightening of the knots *cc*, *bb*, with the knot-tyer *a*.

Fig. 4. *Staphyloplasty.—Dieffenbach's method.—ab* and *ab*, longitudinal incisions made parallel to the borders of the gap.

Plate LI.

STAPHYLORAPHY.

Fig. 1, 2, 3, 4 and 5. *Auguste Berard's mode of operating.*—Fig. 1. The surgeon having seized one of the borders of the cleft with the forceps *a*, is passing a loop of thread *c*, through, from before backwards, by means of the needle-holder *b*.

Fig. 2. The ligatures *a*, *a*, *a*, having been placed in their proper position, the surgeon is paring the edges of the cleft, from above downwards, with the bistoury *c*.

Fig. 3, 4 and 5. These represent theoretically the method of Berard. Fig. 3. Introduction of the first simple thread *bb*, into one of the borders of the wound *aa*. Fig. 4. Introduction of the loop of thread *c*. Fig. 5. The loop of thread *c*, drawing the extremity *b* of the ligature through, from behind forwards.

Fig. 6, 7, 8 and 9. *Method of de Pierris.*—Fig. 6. Application of the instrument behind one of the borders of the cleft; *c*, a moveable thimble retaining a loop of thread *a*. *b*, a barbed needle sheathed in a canula.

Fig. 7. The canula carried to the anterior aspect of the flap. *b*, the moveable needle just before it is thrust through the lip of the flap.

Fig. 8. The needle *b*, forced on by the surgeon, after passing through the substance of the soft palate, raises the moveable thimble *c*, and receives into its notch the loop of thread *a*.

Fig. 9. The needle being withdrawn, brings with it the loop of thread *a*.

Pl. 51.

Fig. 1.

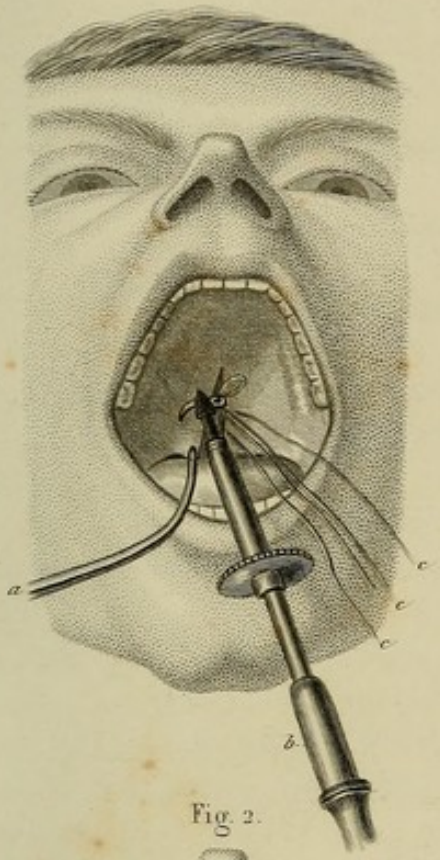


Fig. 2.

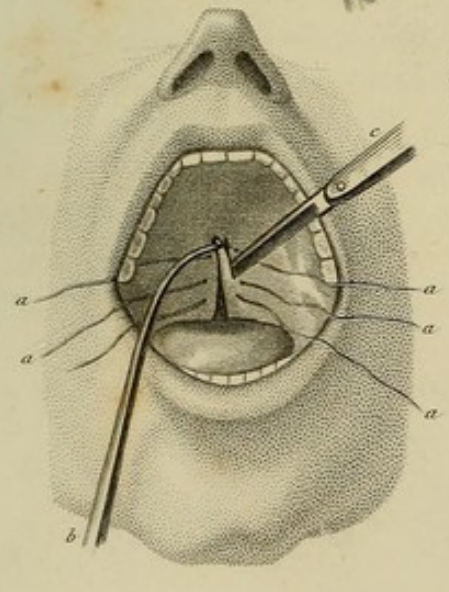


Fig. 3.

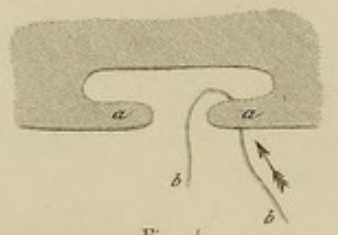


Fig. 4

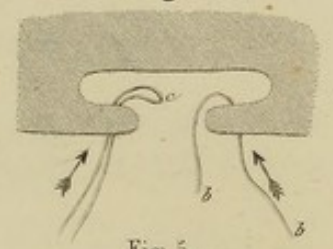


Fig. 5.

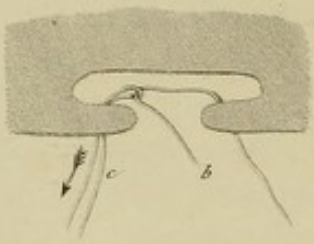


Fig. 6.

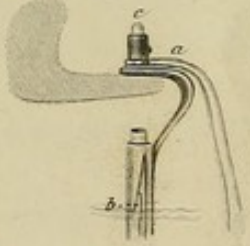


Fig. 7.

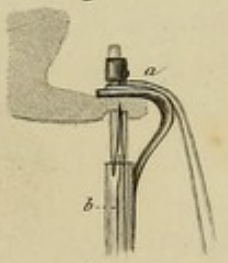


Fig. 8.

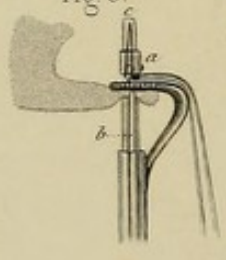
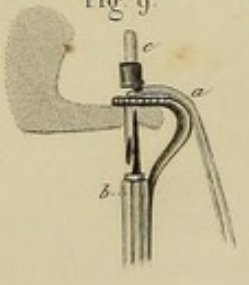


Fig. 9.



CLEFT PALATE.

(*Plates* 50 *and* 51.)

MODES OF OPERATING.

Divisions of the arch of the palate are almost always the result of congenital deformity, and present themselves under three different forms.

1st. *Simple division* of the arch of the palate only, consists of a fissure of the soft parts in the median line, without loss of substance. 2d. *Incomplete division of the palatine arch*, with separation of the bones. 3d. *Complete division of the palatine arch*, in which the bones and soft parts are completely divided throughout the entire length of the arch of the palate to the dental arch. This division may extend to the lips, and be complicated with hare lip (see hare lip, plates 44 and 45.)

The surgical operations employed to remedy these deformities are, 1st, *Staphyloraphy*, for simple division; 2d, *Staphyloplasty*, a modification of staphyloraphy, for incomplete divisions; 3d, *Palatoplasty* or *uranoplasty*, by which the loss of substance in the arch of the palate is repaired.

1st. *Staphyloraphy.*—This operation was performed during the last century by a French dentist, named Le Monnier; in 1817 Graefe attempted it, but without success. Roux (1819) gave a proper shape to the operation, and performed it with success. Staphyloraphy is in all cases a long and delicate operation, and requires the entire co-operation of the patient; on this account it is only advised for persons who have attained the age of discretion. It consists of three principal stages; 1st, Paring off the edges of the solution of continuity; 2d, The insertion of the threads for bringing together the bleeding edges; 3d, The ligature of these threads.

Roux's method.—Apparatus (Instruments, plate XIII). This consists of, 1st, Three flat ligatures, each formed of two or three well waxed threads; 2d, Six small curved flat needles; a needle is attached to each and of the ligatures; 3d, A needle holder (fig. 13); 4th, A

pair of dressing forceps; 5th, A probe-pointed bistoury; 6th, Roux's bent scissors (fig. 7).

1st *Stage.—Insertion of the ligatures* (plate 50, fig. 1).—The patient being seated opposite the light, with his head thrown back upon the breast of an assistant, his mouth should be kept widely extended by means of a cork placed between the molar teeth; the surgeon, standing in front, seizes with the forceps *b* in his left hand, the right margin of the cleft, and with his right, armed with the needle holder *a*, carries the point of the needle backward through the cleft, behind the velum palati, and brings it out from behind forwards, piercing the substance of the velum with its point, about three or four lines from the free borders of the division. The needle being carried through to its eye, is loosened from the holders, and its point being caught by the forceps is brought into the mouth, drawing with it the end of the ligature with which it is threaded. After giving the patient a little rest, the same manœuvre is effected upon the left lip of the division, with the needle attached to the other extremity of the ligature. The ends of the ligature are then brought out of the mouth. The lowest ligature should be inserted first, the uppermost second, and the middle ligature, last of all. Figure 1 represents the act of inserting the third ligature.

The ends of the ligatures *cc*, *dd* being brought out externally, and the loop which they form in the mouth depressed towards the pharynx, the surgeon proceeds to the second stage of the operation.

2d *Stage.—Paring off the edges of the cleft* (fig. 2).—To pare off the edges of the cleft which are to be brought together, the surgeon seizes them with the forceps *d* in one hand, and with the other, armed with bent scissors, or a probe-pointed bistoury *e*, cuts off the borders, from behind forward, on the inner side of the ligatures *aa*, *bb*, *cc*; then, with the probe-pointed bistoury, he completes the flap by prolonging the incision a short distance beyond the angle where the borders of the division are united. The other lip of the cleft is operated upon in the same way, and the two incisions are brought together at the termination of the first.

3d *Stage.—Tightening of the knot* (fig. 3).—Roux begins by tightening the posterior ligature with the fingers, and after making a simple knot, gives the threads to an assistant, who keeps the ligature *bb* in position by means of the ring forceps *a*, during the process of tightening the second and then the third ligature *cc*. These liga-

tures are drawn tighter than is necessary to bring together the edges of the wound, in order to prevent any separation in the interval between them. The operation being concluded (fig. 4), the ends of the ligatures are cut off close to the knots. The patient retains the utmost possible quiet and silence, and abstains from solid or liquid food during two or three days. Everything which tends to move the arch of the palate endangers the success of the operation. The ligatures are not removed until the third or fourth day. The inferior ligature should be allowed to remain for twenty-four or forty-eight hours longer.

It has been asserted that there are some imperfections in this method of Roux. A great deal of dexterity is necessary to avoid the accidents which might happen to less practised hands than those of the author. In fact, it is essential that the ligatures should be placed at equal distances from each other; that the corresponding points of the same ligature be on the same level; and that they be at an appropriate and equal distance from the borders of the division. If these conditions are not fulfilled, an uniform junction, without wrinkling or laceration of the lips of the wound, cannot be hoped for. The difficulties of an operation in which the ligatures are inserted from behind forward, and where the exact point at which the needle enters the arch of the palate cannot be seen, will be readily appreciated. Besides, the paring of the edges of the division is always difficult, when it is effected with the bistoury, and, with the scissors, there is danger of cutting the ligatures. To avert these accidents and inconveniences, the methods which we are about to describe have been invented.

Method of Berard (plate 51).—Two principal modifications characterize this operation. 1st, The ligatures are inserted from before backward into the lips of the division, which allows the surgeon to see and choose the point of puncture with the needle; 2d, The paring of the edges of the division is made from before backward and from above downward. The lips being put more upon the stretch allow the surgeon to make a cleaner incision.

In performing this operation, Berard used a pair of mouse-toothed forceps to hold the arch of the palate; a pair of dressing forceps answered the purpose of a needle-holder, and the needles employed were very much curved, from six to eight lines in length by one in diameter, with a heel about a fourth of a line in length.

The patient being placed as in the operation of Roux (fig. 1), an

edge of the cleft is seized with the forceps *a* in one hand, while the other with the needle-holder *b* inserts the first ligature from before backward into its substance. The needle is then brought out into the mouth, and the ends of the thread *cc* hang down externally upon the lower lip.

Figure 3 represents this first step of the operation. The thread *bb*, carried through a lip *a*, of the cleft. A second needle is then passed through the other lip in the same way, on a level with the first, but with this difference, that the second needle has a loop instead of a single thread in its eye. Figure 4 represents the loop of thread *c*, inserted into the other lip opposite the thread *bb*. This loop of thread receives the end *b* of the first ligature and draws it through the second lip, in the direction of the arrow *c* (fig. 5).

The first ligature being placed in its proper position, the surgeon proceeds to insert the two others in the same manner.

The paring is effected from below upwards (fig. 2). The surgeon seizes each border of the cleft with the forceps *b*, and pares off the edges with the bistoury *c*.

Velpeau commences the operation by paring off the edges of the bifurcation before inserting the ligatures.

The other modes of operating differ from the preceding only in the instruments employed. Attempts have been made to avoid the difficulties of the various stages of the operation by the use of ingenious instruments which would allow the surgeon to act with greater rapidity and certainty, either in the insertion of the ligatures, or in paring off the edges of the cleft. A description of all the instruments invented for this purpose would be too long for this work. Besides, surgeons who have these instruments before them will comprehend their mechanism at first sight. We will mention a few of the instruments sanctioned by experience.

Dr. N. R. Smith, of Baltimore, has invented a needle, which consists of a steel shank, mounted upon a handle, and curved towards its point in a semi-circle with a radius of about half an inch. There is no eye in the point of the needle, but it is somewhat enlarged and has a notch in its side in which a ligature is inserted. With the ligature thus supported, the needle is thrust from behind forward through one border of the cleft, and as soon as the notch makes its appearance, the ligature is drawn out of it; the instrument is then withdrawn and the

other extremity of the ligature is carried in the same way through the opposite lip of the cleft.

Bourgougnon uses a needle with a moveable point (Instruments, plate XIII., fig. 8, 9, 10 and 11), with which the perforation can be made from behind forward. Other needles of the same sort, both curved and straight, have been used in making the perforation from before backward.

Leroy d' Etiolles has invented an instrument which makes the three perforations and pares off the edges of the cleft, at the same time.

Foraytier and de Pierris use needle-holders, which support the border of the cleft, while the needle, with its ligature attached, is pushed through from before backward (Instruments, plate XIII., fig. 14 and 15, needle-holder of de Pierris). For the description of the mechanism of this instrument (see the explanation of plate 51, fig. 6, 7, 8 and 9).

2d. *Staphyloplasty.*—The loss of substance which constitutes fissure of the arch of the palate is frequently so great as to render junction of the lips of the division impossible, by the operation of staphyloraphy; staphyloplasty should then be attempted, for which there are three methods.

Roux's method.—Roux makes two transverse incisions on either side of the cleft, and carries them outward, parallel with and beyond the division, along the posterior border of the palatine bones, in order to facilitate the extensibility of the parts which are to be brought together, subsequently, in the usual mode.

Dieffenbach's method (plate 50, fig. 4).—Dieffenbach, imitating Celsus, made a longitudinal incision *aa*, *bb*, parallel to and on each side of the division, about four or five lines from its borders.

Bonfils cut a flap on each side of the cleft, which he dissected up from before backward, twisted upon its pedicle, and applied upon the solution of continuity. This operation, derived from the Indian method, is not so easily performed as those of Roux and Dieffenbach.

3d. *Palatoplasty.*—When the palatine fissure is very considerable, the operation of Roux may be attempted, which consists in dissecting up the soft parts to the outer side of the ligatures, and isolating them from the bones, when they can be easily brought together. For this dissection Roux uses small double-edged knives, with narrow blades, and curved on one face.

Krimer detached two lateral flaps, which he reversed upon themselves, and brought them together over the fissure by points of suture.

It is difficult to determine the comparative value of the different operations for palatoplasty; the surgeon must be influenced in his choice by the shape and extent of the fissure.*

* Our authors have omitted all notice of the very important improvements effected of late years in the operations for cleft palate by our countryman Dr. John Mason Warren, of Boston, and by Prof. Fergusson, of Kings' College, London.

In his paper on "*Operations for fissure of the soft and hard palate*," published in the New England Quarterly Journal of Medicine and Surgery, April, 1843, p. 538, Dr. Mason Warren details instances of successful closure of fissures in the hard palate, by dissecting up flaps from the concave surface of the roof of the mouth, commencing at the margins of the fissure upon either side, and extending outwards as far as the alveolar projections; these flaps being rendered continuous with the corresponding borders of the fissure in the soft palate, and all being united in the median line, were found to produce a result in regard to the permanent closure of the fissure of the hard palate, which had not been hitherto attained, and the credit of which belongs to Dr. W. In addition to this improvement, Dr. Warren also announces in this paper, for the first time, the great advantages to be attained in securing union of the flaps formed by the soft palate, by *dividing the anterior pillar of the palate on either side, and* "*cutting away its attachments to the tonsil and to the posterior pillar.*"

On the 10th of December, 1844, Prof. Fergusson read before the Royal Medico-Chirurgical Society of London, an admirable paper "on cleft palate and on staphyloraphy," in which he proposes, "on strictly scientific grounds, and in accordance with the modern principles of myotomy," by the systematic division of the *levator palati*, the *palato-pharyngeus*, and the *palato-glossus muscles*, as a preliminary step to the operation of staphyloraphy, "to destroy all motory power in the soft palate for the time being, and thus to permit that repose of the stretched velum which is so essential to a happy result." Med. Chir. Transactions, 1845, p. 288. Prof. F. also details cases successfully treated in accordance with this view.—Ed.

Pl. 52.

Fig 1.

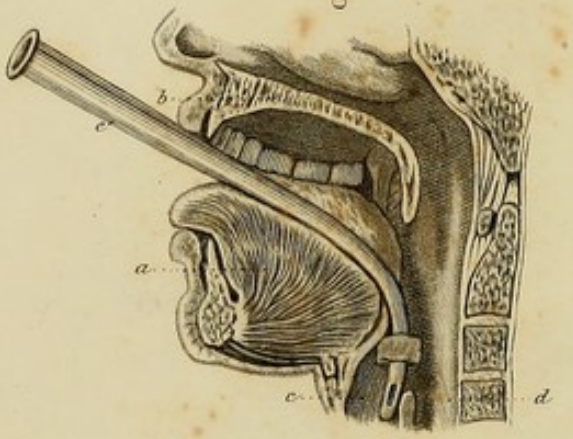


Fig 2.

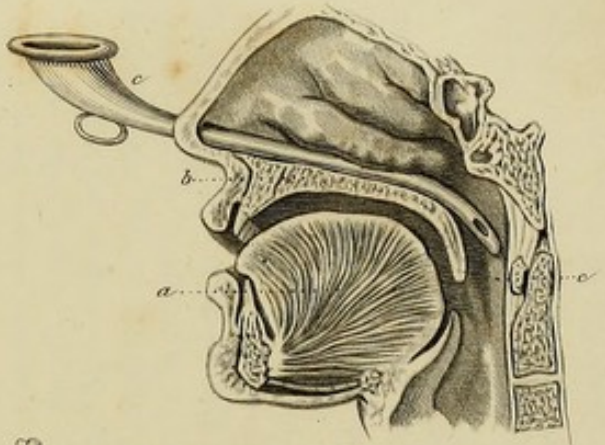


Fig 3.

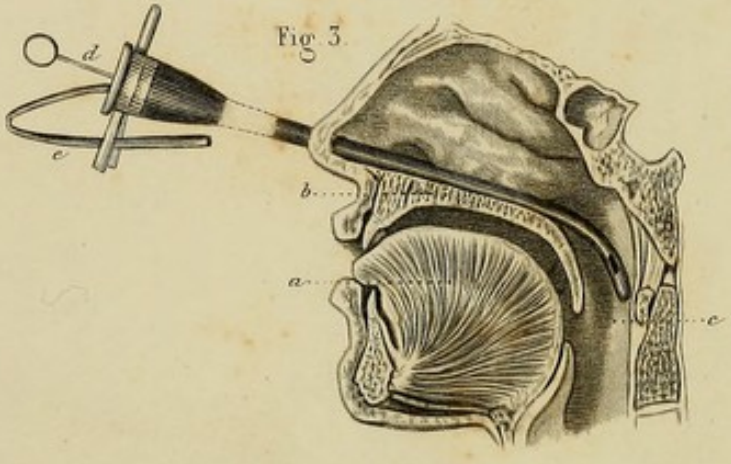


Fig 4.

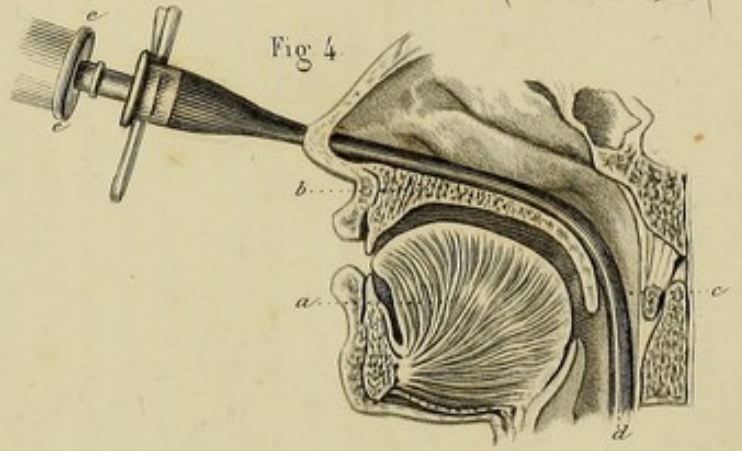


Plate LII.

CATHETERISM OF THE AIR PASSAGES AND THE ÆSOPHAGUS.

Figures 1, 2, 3 and 4, represent an antero-posterior vertical section, showing the anatomy of the regions through which the sound passes.

Fig. 1. *Catheterism of the air passages.—Chaussier's method.*—*a*, the tongue; *b*, floor of the nasal fossæ; *e*, laryngeal tube whose extremity is carried into the larynx *c*; *d*, the æsophagus.

Fig. 2. *Catheterism of the œsophagus for the artificial feeding of lunatics.*—*a*, the tongue; *b*, floor of the nasal fossæ; *c*, sound with a funnel-shaped extremity; *e*, the pharynx.

Fig. 3. *Catheterism of the œsophagus.—Method of Baillarger.*—The point of Baillarger's sound is engaged in the upper part of the pharynx *c*; *d*, stylet of iron wire; *e*, a whalebone stylet.

Fig. 4. *Same operation.*—The catheter *d*, is carried into the æsophagus *c*; *ee*, extremity of a syringe for injecting food.

CATHETERISM OF THE ÆSOPHAGUS.

SURGICAL ANATOMY.

The *œsophagus* is a long muscular canal, commencing at the pharynx and terminating in the stomach; it is slightly flattened from before backwards, is about an inch in diameter; posteriorly it is closely connected with the vertebral column, and anteriorly with the trachea. It is slightly inclined to the left, on which account the operation of œsophagotomy is usually performed on this side of the neck. The pharyngeal orifice of the œsophagus is on a level with the cricoid cartilage; this orifice is liable to spasmodic contractions, which are frequently an obstacle to the introduction of instruments.

MODES OF OPERATING.

Catheterism of the œsophagus is performed for the artificial introduction of food into the stomach, or, for the evacuation of its contents; it is also performed to ascertain the presence of foreign bodies in the canal, which are to be extracted, or forced into the stomach.

Evacuation of the contents of the stomach is performed in cases of poisoning. A quantity of tepid water, or some other liquid to dilute the poisonous substances, is first injected. After which a pump of proper size is used to draw out the liquid.

Catheterism of the œsophagus may be performed either through the nostrils or the mouth.

Catheterism by the nostrils.—Desault's method.—A gum-elastic catheter, furnished with a stylet of iron wire, is used; a slight curve being given to the point of the instrument, which should be held like a writing pen, it is introduced, with the concavity downwards, by sliding the point of the catheter along the floor of the nasal cavity. When the point of the instrument touches the posterior wall of the pharynx, the stylet should be withdrawn with one hand while the other forces the catheter onward. The instrument being thus introduced into the superior orifice of the pharynx, by pushing it onward, it passes through the œsophagus into the stomach. If the catheter-

ism is performed for the purpose of introducing food into the stomach, the surgeon after satisfying himself of the position of the catheter, may proceed to inject the alimentary substances through it with the syringe *e e* (fig. 4).

If the instrument has taken a wrong direction, and been introduced into the larynx, it is recognised, 1st, By the convulsive cough and suffocation which are instantly produced; 2d, By the injection of the face, with dilatation of the jugular veins and violent spasms; 3d, By the impossibility of articulating experienced by the patient. This last symptom is of the greatest value, as it is the only one which may not be exhibited when catheters are introduced into the æsophagus. Therefore the surgeon is advised not to commence the injection of substances until a few words are pronounced by the patient undergoing the operation.*

Method of Baillarger (Plate 52, fig. 3).—This method is particu larly applicable to insane persons, because it allows the surgeon to direct the catheter with more security in a class of patients whose disinclination or opposition may baffle the greatest dexterity. Baillarger uses a catheter with a double stylet (Instruments, plate XIV., fig. 7).

One stylet *d*, is made of iron wire, the other *e*, of whalebone. The two stylets being introduced, follow the curve already given to the extremity of the instrument; but the stylet of iron wire maintains the original curve of the catheter, which the whalebone stylet tends continually to straighten. The catheter is introduced by one of the nostrils, and when its extremity strikes the posterior wall of the pharynx (fig. 3), the iron wire *d*, is withdrawn, and the whalebone *e*, alone remaining, straightens the curve of the instrument while it pushes its extremity backward against the vertebral column. This action of the whalebone stylet forces the point of the catheter from the opening of the larynx, and consequently diminishes the danger of giving a wrong direction to the instrument.

Method of Blanche.—To attain the same result with a simpler instrument, which is more completely under the control of the surgeon, Blanche uses a jointed stylet (Instruments, plate XIV., fig. 5 and 6), in the middle of which is a central shank terminated by a

* The flame of a candle held before the orifice of the catheter, during expiration, will speedily determine the fact if the instrument has passed into the larynx.—Ed.

ring *e*, into which the surgeon inserts his thumb; into two other rings, *a* and *b*, the index and middle fingers are introduced; the middle shank, according as it is pushed on or withdrawn, gives to the jointed stylet all the curves necessary for the introduction of the catheter. This very ingenious instrument allows the surgeon to act with a rapidity and precision which exempts the patient from the dangers and pain of the other methods.

Method of Falret and Ferrus.—In the great majority of cases, the conveyance of food to the pharynx overcomes the opposition of insane persons, where the sensation which it occasions excites the instinctive movements by which deglutition is effected. Being aware of this fact, Falret and Ferrus feed patients artificially, by using a simple female catheter, whose external extremity is shaped like a funnel. The catheter is introduced by the nostrils (fig. 2), and the food, poured by the spoonful into the funnel-shaped extremity of the instrument is carried to the superior orifice of the æsophagus, whence it descends into the stomach.

STRICTURE OF THE ÆSOPHAGUS.

The causes are numerous which occasion stricture of the æsophagus, and we will not detail them. The existence of stricture being determined, the main indication is to facilitate the introduction of food into the stomach. Catheterism is performed with a hollow instrument of greater or less dimensions, which in certain cases may be permanently retained. Various dilating instruments, and cauterization with the nitrate of silver, have been recommended. These different means may therefore be employed in those cases of stricture whose nature may justify their use.

Dilatation by graduated bougies, performed as for strictures of the urethra, offers a convenient method free from danger, which can be employed for strictures resulting from induration, or chronic inflammation of the tissues. *Cauterization* is not always applicable; this operation is a delicate one on account of the extreme difficulty of determining the exact seat of the stricture.

EXTRACTION OF FOREIGN SUBSTANCES.

Foreign bodies which are liable to be arrested and impacted in the æsophagus, may be arranged under two heads: one class from their

being of a digestive nature may become softened, and descend little by little, into the stomach; by performing catheterization we can assist them in their passage downwards. The other class, consisting of solid, irregular, angular, pointed substances, may remain for a longer or shorter time in the æsophagus, and give rise to the gravest symptoms. In all cases, catheterism will furnish the necessary information as to the nature, form and situation of the foreign body, and the most simple means will frequently suffice to effect its descent. Swallowing oily and mucilaginous liquids will sometimes facilitate the passage of rounded solid bodies. Soft bodies of considerable size, such as a mouthful of bread, distend the canal in their passage, and may carry down with them small irregular or pointed bodies, such as fragments of bones or fish bones. But still it is frequently necessary to have recourse to catheterism to effect their descent into the stomach. This should be performed with a bougie, or with a piece of flexible whalebone, called a probang, to whose extremity a small sponge is attached. Ambrose Paré and modern surgeons have frequently used successfully the stem of a leek.

Extraction by the mouth.—Extraction may be performed, 1st, When the foreign body is lodged in the pharynx, or at the commencement of the æsophagus; it may be seized with the fingers, or with a pair of long curved forceps; 2d, When the foreign body, still more deeply lodged, cannot, either from its shape or nature, be forced downward without danger.

The instruments invented for the operation of extraction, beside curved forceps, are too numerous for us to describe, and we shall limit ourselves to the description of those most in use, and indicate their mode of action. All of them are intended to operate from below upward, and to bring the foreign substance into the mouth; they have the appearance of hooks, which when closed are easily carried down between the body and the inner wall of the æsophagus. When passed below the foreign body, they open in such a way, during their withdrawal, as to bring up the body with them. In this category may be included the whalebone bougies, armed with a sponge which is introduced dry and compressed, beyond the foreign substance, and when the sponge has become swelled by the moisture of the part, is withdrawn; the threads of unspun flax of Delahaye; the strings of beads of Ollenroth; the umbrella shaped instrument of Baudens, etc. The double moveable hook of Dupuytren (Instruments, plate XIV.,

fig. 9) is much used in France; at one of its extremities is a double hook mounted on a swivel, which is readily introduced when the instrument is withdrawn, the branches of the hook catch the foreign body and bring it out with them. It is impossible to determine the relative value of these means; the circumstances of the case must govern the surgeon in the choice of appropriate instruments, and may suggest modifications of their ordinary modes of use, as well as new resources applicable at the time.

When the methods already described fail, and the foreign body by its prolonged presence has created an inflammation of the æsophagus, the operation of æsophagotomy should be performed.

Pl. 53.

Fig. 1.

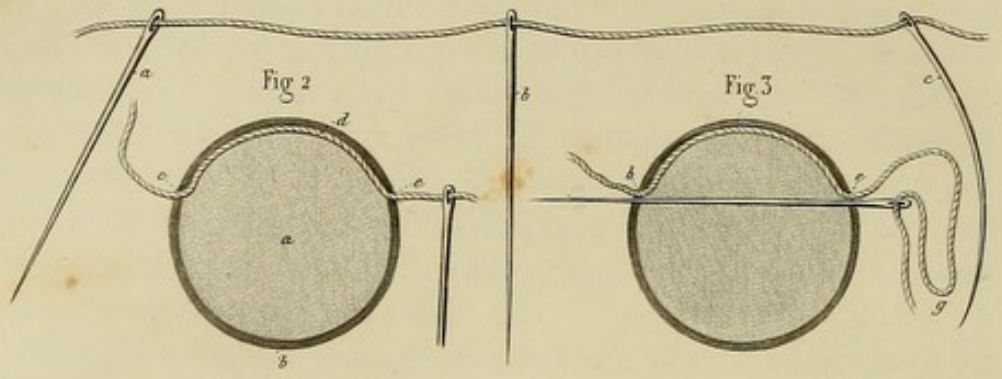


Fig 4

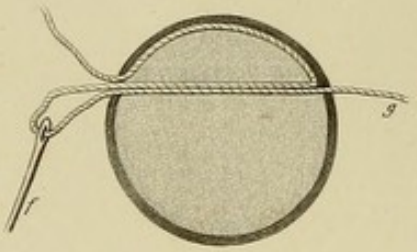


Fig 5

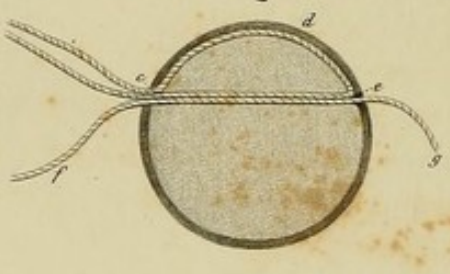


Fig. 6

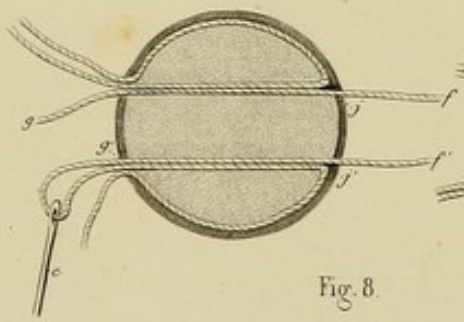


Fig. 7.

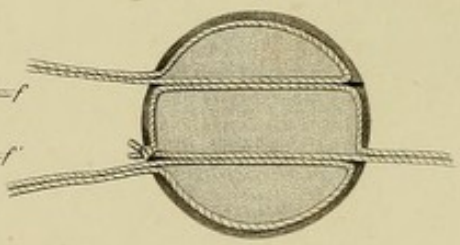


Fig. 8.

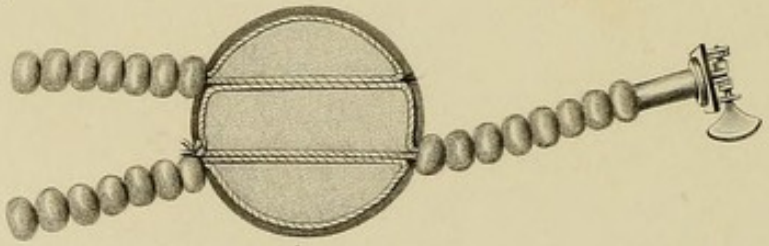


Plate LIII.

GOITRE.—LIGATURE.

Method of Ballard and Rigal de Gaillac.—The figures represent a plane at the base of the tumour, shewing the direction which should be given to the needles.

Fig. 1. A long and strong thread armed with three needles: *a* a straight double-edged needle; *b*, a straight sharp-pointed needle; *c*, a curved needle.

Fig. 2. *a*, the base of the tumour; *b*, the skin. A vertical fold of skin has been raised up on a level with the superior third of the tumour; the double-edged needle and thread being carried through this fold, it is left to itself, and the plate represents the superior third of the tumour surrounded by the thread *c d e*, whose extremities pass out through the skin at the points *c e*. The round-pointed needle hangs upon one extremity of the thread outside of the tumour.

Fig. 3. The round-pointed needle entered at the point *e*, and coming out at the point *b*, passes through the base of the tumour, and draws after it the loop of thread *g*.

Fig. 4. The loop of thread *g*, being cut, disengages the needle *f*.

Fig. 5. The superior third of the tumour is thus surrounded at its base by the loop of thread *c d e*, whose extremities come out at the same point *c*; a second thread *f g*, is also placed above the middle third.

Fig. 6. By repeating, with a second thread (fig. 1), the same operation upon the inferior third of the tumour, the middle third is embraced between two parallel threads *f g*, and *f′ g′*. The curved needle *c* (fig. 1), is easily carried through the skin at *j*, and brought out at *j′*. The extremity *g* on the other side is brought out in the same way at *g′*; these two threads being securely knotted at this point, form by their union a loop which embraces the middle third of the tumour as represented in fig. 7.

Fig. 8. The ends of the ligatures are carried through a knot-tyer resembling a string of beads, and tightened upon a small roll of wood.

Plate LIV.

GOITRE—LIGATURE.

MANEC'S METHOD OF OPERATING.

Fig. 1. A needle, having an eye *a*, about equi-distant from its two extremities.

Fig. 2. Another needle, with an eye *b*, at one of its extremities, large enough to receive a very strong double ligature.

Fig. 3. *a a a a*, a section of the base of the tumour, showing the position of the needles; the female needle, as the one with the eye in its middle may be styled, *b*, is first introduced; the male needle *c*, is then carried through the base of the tumour, and also through the eye of the female needle.

Fig. 4. The female needle *a*, in its original position; the male needle *b*, has been thrust entirely through the tumour, and the double ligature *c c*, has necessarily passed through the eye of the needle *a*.

Fig. 5. The female needle *a*, pushed from above downwards, draws the double ligature *c c*, out of the tumour. One of the ligatures is now cut and detached from its eye.

Fig. 6. The female needle is now withdrawn from below upward; it carries with it the loop of thread *b b*, which is then cut, in order that the needle may be completely detached from the tumour.

Fig. 7. The tumour is thus divided into four parts, each isolated from the other by the four ligatures, *a b c*, *d e f*, *g h i*, *j k l*, whose extremities are united by four knot-tyers, fig. 8, *a*, *b*, *c*, *d*.

Pl. 54.

Fig 1.



Fig 2

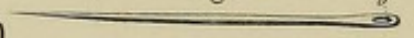


Fig. 3

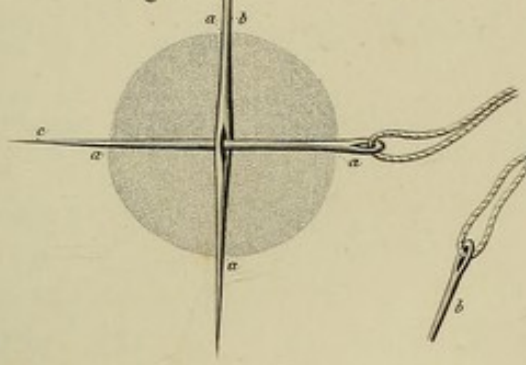


Fig. 4

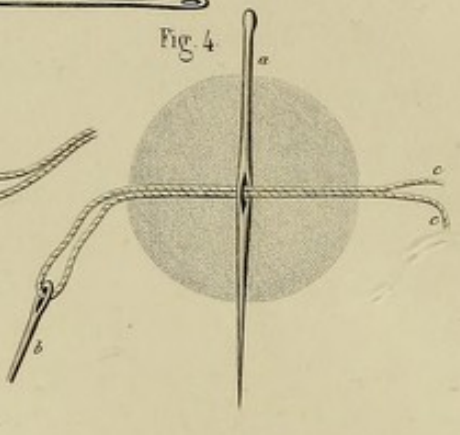


Fig 5.

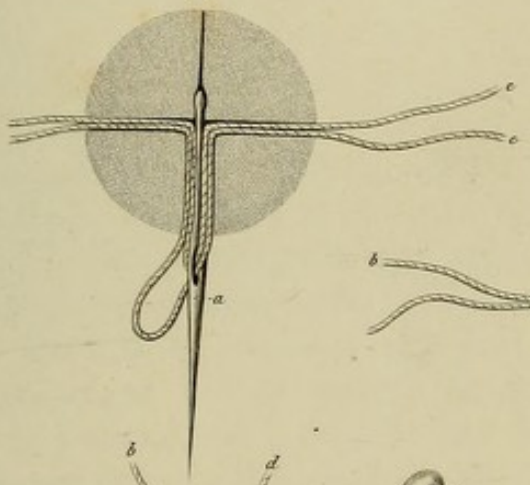


Fig 6

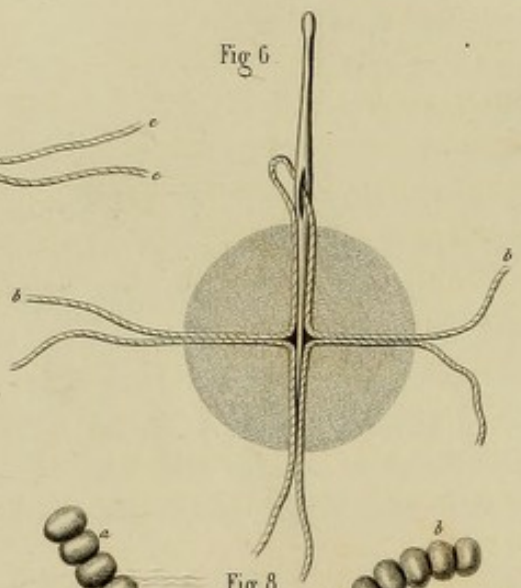


Fig 7

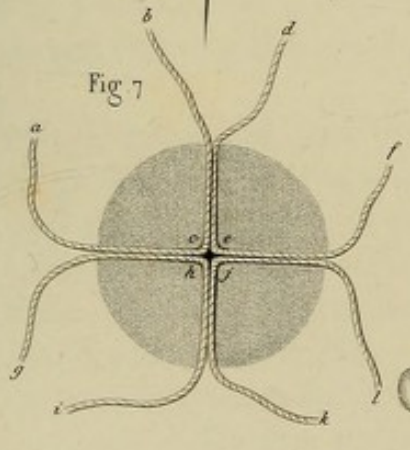
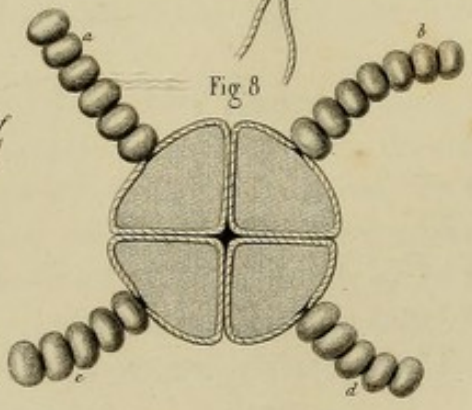


Fig 8



BRONCHOCELE OR GOITRE.

The name of *goitre* or *bronchocele* is given to a swelling of the thyroid body. This enlargement, which is slowly effected, frequently acquires a volume considerable enough to embarrass respiration and deglutition. In the great majority of cases, goitre is the result of an hypertrophy of the thyroid gland, but it may be produced by erectile, tubercular, calcareous, carcinomatous and other tumours. It is therefore necessary, before having recourse to an operation, to understand the nature of the affection, in order to employ the appropriate therapeutic means. In general, the preparations of iodine succeed in simple and recent cases of hypertrophy; puncture is indicated when there are serous or purulent cysts. But when the tissue of the tumour is solid, recourse should be had to some one of the operations about to be described. Cauterization, the seton, ligature of the thyroid arteries, extirpation and ligature in mass have all been employed.

Cauterization.—Cauterization by itself cannot be usefully employed for the treatment of goitres of large size; but combined with some other operations, it may possibly be of benefit. Caustic potash should be preferred, and it must be used with caution to avoid injury to important organs which are met with in the neighborhood of the disease.

Seton.—Employed successfully by the elder Monro, Addison, more recently by Flajani, Maunoir, of Geneva, and Dupuytren, the seton is only applicable to certain tumours whose nature is thoroughly ascertained; it gives rise to suppuration, which occasions a subsidence of the goitre. This method may prove dangerous if employed for carcinomatous tumours. When this operation is performed, a seton should be introduced into each lobe of the tumour and withdrawn as soon as there is evident diminution of the goitre.

Ligature of the Thyroid Arteries.—This operation is specially indicated in cases of erectile tumours, of simple hypertrophy, and when the arteries are rendered superficial by the development of the tumour. To be successful, the arteries on both sides must be tied. This operation has been performed by Carlisle and Chelius.

Extirpation by Ligature.—This operation was first performed by Moreau in 1779. Mayor (of Lausanne) has since modified the operation.

Method of Mayor.—The tumour is brought into view by a double elliptical incision, which allows the skin to be turned back to the right and left; a double ligature consisting of two threads of different colours is then carried through its base; the two extremities of the same coloured ligatures are brought together in order that each half of the tumour may be embraced by itself. If the goitre is of large size and lobulated, a ligature may be applied to each lobe, by carrying long needles, armed with double cords, through the tumour in different directions, so that each lobe may be embraced by itself.

Method of Ballard and Rigal de Gaillac.—Three subcutaneous ligatures were applied around the base of a large goitre. To convey a clear idea of this operation, we have given in plate 53, a series of diagrams, which show the course of the needles and the arrangement of the ligatures at the base of the tumour.

Method of Manec (see plate 54).—By an operation more simple and requiring less time in its execution than the preceding, Manec has strangulated the pedicle of a large goitre, by means of four ligatures, each of which acts from the centre towards the periphery of the tumour.

The instruments consist of two straight needles, which should be about an inch longer than the greatest diameter of the tumour. One of them, which we shall call the *female needle*, to facilitate the description, should be flat, sharp upon its edges, and pierced about midway from its extremities with an eye large enough to allow the other, or *male needle*, to be passed easily through it; this second needle, has at one of its extremities an eye for the reception of two very strong ligatures of different colours.

The surgeon commences by transfixing the tumour at its base with the female needle, so that the eye of this needle will remain at about the middle of the tumour; this instrument being allowed to remain, the male needle, threaded with a double ligature, is carried at right angles with the first through the base of the tumour, and at the same time through the eye of the female needle. When the surgeon has satisfied himself that the male needle, with its ligatures has passed through the eye of the female needle, the male needle is detached by

cutting the ligature, whose extremities then hang out at the right and left of the tumour.

The female needle is then pushed downward and carries with it the ligatures passed through its eye; one of these cords is now cut close to the needle, and by this means one half of the tumour is again subdivided into two other halves, each of which is embraced by a loop of cord. The same manœuvre is then repeated in the opposite direction, in order to effect the ligature of the second half, and the base of the tumour is thus traversed by four ligatures, by each of which a fourth part of the tumour may be strangulated.

Extirpation.—This operation, one of the most serious in surgery, should be performed only in extreme cases where the patient is in imminent danger of suffocation. The surgical anatomy of the thyroid regions explains the dangers which threaten a patient during the extirpation of a goitre. Extensive hemorrhage, and the introduction of air into the veins are to be feared. But few successful cases are on record, and nothing but the most imperious necessity should tempt the surgeon to perform the operation. The anatomical details (plate 55) indicate the precautions necessary to take to avoid injuring the larger vessels and nerves, which are in close connection with the thyroid gland. By combining the ligature with extirpation, the surgeon will avoid more than one danger. Mayor has performed this mixed operation with success.

CATHETERISM OF THE AIR PASSAGES.

(*Plate* 52, *Fig.* 1.)

The object of this operation is to maintain respiration either by insufflation, or by means of a catheter permanently retained in the larynx. It is performed for œdema of the glottis, asphyxia, and most frequently in newly born children. The instrument may be introduced by the nose or mouth.

1st. *Introduction by the nose.—Desault's method.*—A gum-elastic catheter of large size, furnished with a properly curved stylet, is introduced along the floor of one of the nasal fossæ as far as the pharynx; the jaws of the patient are kept apart by pieces of cork placed between them, in order that the surgeon may be enabled to reach the extremity of the instruments in the throat with his fingers, or a pair of

forceps. The stylet is then withdrawn and the end of the catheter, passing over the base of the tongue, is pushed onwards in such a direction that it will enter the larynx. When the catheter enters the larynx, the hand of the surgeon experiences a sensation as if an obstacle had been overcome, the patient is seized with a sudden cough and a spasmodic elevation of the larynx is remarked; during expiration, the air makes its exit through the catheter. All these symptoms are wanting if the instrument has passed into the æsophagus; should this be the case, the catheter must be withdrawn and the manœuvre again attempted.

This operation is performed only in cases where the catheter is to be permanently retained.* For asphyxiated infants the following method is preferred:

2d. *Introduction by the mouth.—Chaussier's method* (plate 52, fig. 1).—Chaussier used a silver tube of some six or seven inches in length, curved towards its extremity, and pierced with an orifice on each of its sides for the passage of the air; above these openings was fastened a small disk of agaric or sponge for the purpose of closing completely the superior orifice of the larynx above them. Depaul has modified Chaussier's instrument by making a single opening at the extremity of the instrument instead of the lateral orifices.

The infant should be laid upon its back, with its chest raised a little higher than the pelvis, the head being thrown slightly backward and the neck brought forward; the surgeon commences by removing the mucus from the mouth and pharynx, and then slides the little finger of his left hand along the tongue as far as the epiglottis; and now, taking the laryngeal tube in his right hand, he carries it along the finger of his left hand to the epiglottis. A movement of the extremity of the tube raises the epiglottis and the surgeon pushes the instrument into the larynx until the superior orifice of the latter is completely closed by the disk of agaric or sponge.

If the tube has been introduced into the larynx, the chest is dilated by the insufflation; on the contrary, if the instrument has entered the

* The permanent retention of a tube or catheter, passed into the larynx through its superior orifice, is a measure hardly recognized by modern surgery. Bronchotomy is the operation undoubtedly indicated in all cases for which catheterism of the larynx was formerly proposed. The use of the catheter, as described in the text, is therefore only applicable to the resuscitation of children born in a state of asphyxia, and for the purpose of effecting artificial respiration.—Ed.

æsophagus the abdomen is first distended. To insure the success of the operation Depaul advises the surgeon to compress the lips on each side of the canula with the thumb and fore-finger of each hand while the two middle fingers pressing upon the nostrils close the nose.

The operation commences by sucking out the mucus which fills the trachea and bronchial tubes, and then, imitating the regular movements of respiration, the operator performs insufflation from his own lungs. After each insufflation the mouth of the canula should be left free; insufflation must be performed slowly and cautiously in order to avoid rupturing the air cells by the sudden and violent introduction of too great a quantity of air. Twelve or fifteen insufflations per minute are sufficient, after each of which gentle pressure should be made with the hands upon the parietes of the chest to impress upon the ribs the movement natural to expiration.

Frequently an hour elapses after the commencement of insufflation before the child exhibits appearances of animation, and the heart begins to beat; it is therefore necessary to proceed slowly and patiently. The surgeon should not cease his efforts before the heart beats an hundred and twenty or thirty times per minute.

PLATE. LV.

ÆSOPHAGOTOMY.

FIGURES 1 AND 2. SURGICAL ANATOMY.

FIG. 1. As the æsophagus in its passage downwards deviates slightly to the left, it is advantageously approached on the left side of the neck. After the removal of the skin and the platysma myoides, the sterno-cleido-mastoid *q*, and the muscles in front of the larynx *e f*, are brought into view; the external jugular vein *h h*, which crosses the sterno-mastoid muscle, is rarely included within the limits of the incision. On a level with the os-hyoides C, in the cellular space which separates the internal border of the sterno-mastoid from the sterno-thyroid and omo-hyoid muscles, is found the superior laryngeal nerve, and the lingual, facial *b*, and superior thyroid *d*, arteries; therefore, the incision should commence at least half an inch below the os-hyoides.

FIG. 2. Beneath the sterno-mastoid muscle *g g*, lies the carotid artery *j*, and the deep jugular vein *i*, contained in a cellular sheath. These great vessels gradually approach the æsophagus L, more closely as it descends, particularly on the left side of the neck. By drawing the muscles in front of the larynx towards the median line, the trachea G, is exposed; this lies in front of the æsophagus L; lower down, is found the inferior thyroid artery *f*. To avoid this artery, the incision should not be carried lower than within two or three fingers' breadth of the sternum. Above, on a level with the os-hyoides C, are found the facial, lingual *b*, and the superior thyroid arteries already mentioned (fig. 1).

FIG. 3. *Æsophagotomy; operation*, *a a*, an incision made in the direction of the inner border of the sterno-cleido-mastoid muscle. The left hand of the surgeon *b*, is drawing backward and outward the internal border of the sterno-mastoid *c*, together with the carotid

Pl. 55.

Fig. 1.



Fig. 2.

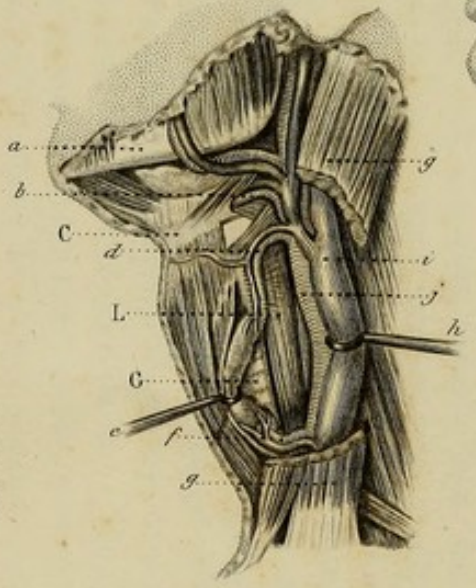
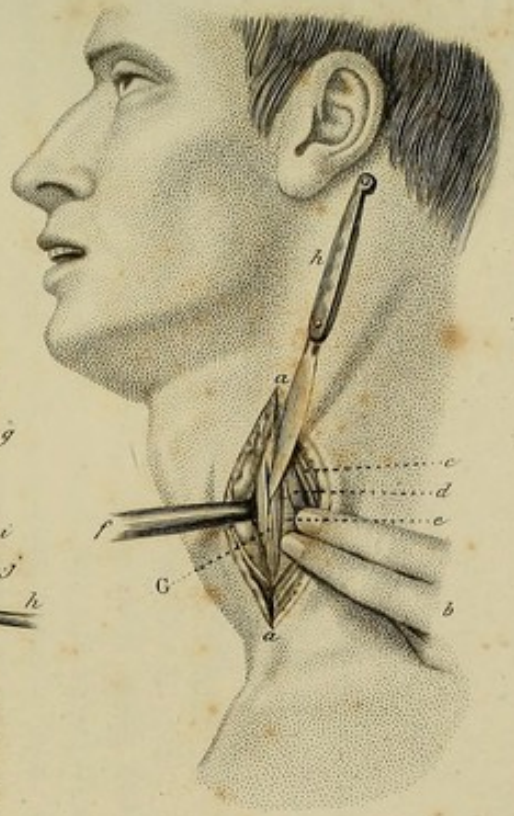


Fig. 3.



artery *e*, and the internal jugular vein *d*; the trachea and the muscles in front of the larynx are drawn towards the median line with the blunt hook *f*; the surgeon is making an opening in the œsophagus G, with the bistoury *h*.

MODES OF OPERATING.

The patient lies upon his right side, with his head slightly thrown backward, and inclined to the right, and the neck a little raised. The surgeon takes his position on the left of the patient, so that he can make the incision with his right hand, while with his left he draws aside and protects the organs necessary to avoid.

An assistant on the patient's right, with blunt hooks, stands ready to draw aside the left lip of the wound, the sub-hyoid muscles and the trachea. The surgeon with a convex bistoury then makes an incision from two to four inches in length, parallel to the trachea and in the intermediate space which separates the sterno-mastoid from the sterno-thyroid muscle. This incision should be carried successively through the skin, the platysma myoides and the cervical aponeurosis; the cellular tissue beneath must be carefully divided, and pushed aside; the fingers of the surgeon's left hand should draw aside the internal border of the sterno-mastoid muscle, while the assistant gently draws the laryngo-tracheal mass towards the median line. The trachea must be handled very cautiously, so as not to embarrass respiration; attacks of suffocation which would expose the patient to a certain amount of danger, might be occasioned by pressure upon this organ. The omo-hyoid muscle presents itself passing diagonally across the wound; if convenient it should be separated and drawn upward; if not, a director should be passed under it, and it must then be divided with the bistoury. A little behind and at the bottom of the wound, is found the cellular sheath of the large vessels *d*, *e*, which should be drawn aside from the course of the œsophagus; previous to doing this the assistant depresses the trachea with a blunt hook. The œsophagus now presents itself at the bottom of the wound, having the appearance of a broad muscular fasciculus lying upon the cervical vertebræ. The foreign body, by the projection which it causes, frequently renders it more prominent. The patient may now be directed to make an attempt to swallow, which will cause a contraction and hardening of the muscular fasciculus.

The æsophagus being satisfactorily recognised, a small puncture should be made with the bistoury, which answers as the commencement of an incision, at first very moderate in extent, but which can afterwards be enlarged by a probe-pointed bistoury sufficiently for the ready extraction of the foreign body.

If the surgeon does not recognise the æsophagus in the middle of the wound, he should have recourse to catheterism to assist his explorations, and then make the incision. Catheterism is above all necessary when the foreign body is situated below the wound and cannot consequently by its projection furnish any visible indication of its seat. A simple catheter, or æsophagus bougie, will supply the necessary indication, and also furnish a starting point for the puncture. The instrument with a concealed knife, of frère côme, may be used; by pushing out the concealed blade at the place of election, a puncture is produced which leaves a passage for the probe-pointed bistoury. But the most convenient instrument is Vacca's bougie (Instruments, plate XIV., fig. 8). A portion of this instrument is perforated; a grooved stylet acting as a spring projects from the opening when the button *b* is turned. The projection caused by this spring serves as a guide for the surgeon in making his incision.

The incision being made, the foreign body must be extracted; for this purpose, polypus forceps, tenacula, hooks, etc., etc., may be useful. No general rule can be given for performing the manipulations necessary for extraction. The nature and form of the foreign body, and the depth of its situation must furnish the indications for the manœuvres to be undertaken.

After the operation, the lips of the wound should be moderately approximated and dressed in with lint; union by the first intention should not be attempted. If the incision in the æsophagus is very extensive; it would be prudent to introduce a catheter which may be allowed to remain for four or five days, through which food could be conveyed into the stomach, if necessary, and thus prevented from escaping into the wound.*

* Unless the wound in the æsophagus has been of necessity very large, there is no good reason why union by the first intention should not be attempted after this operation.—Ed.

Fig. 1.

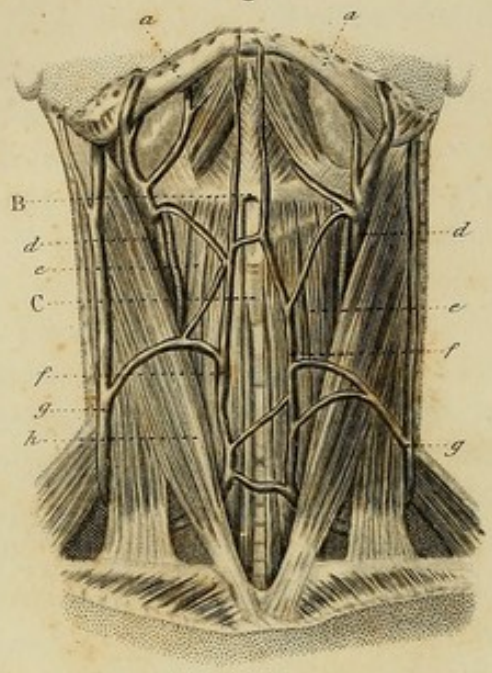


Fig. 2.

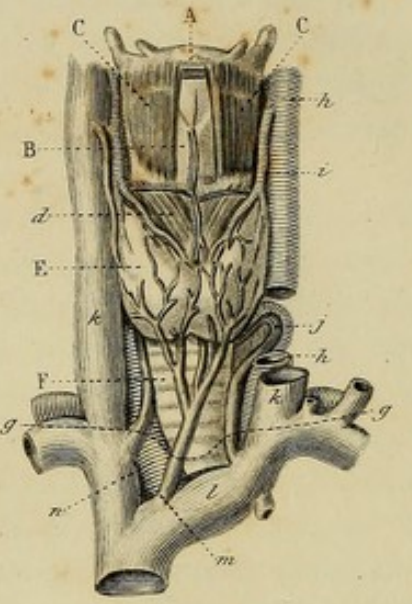


Fig. 3.

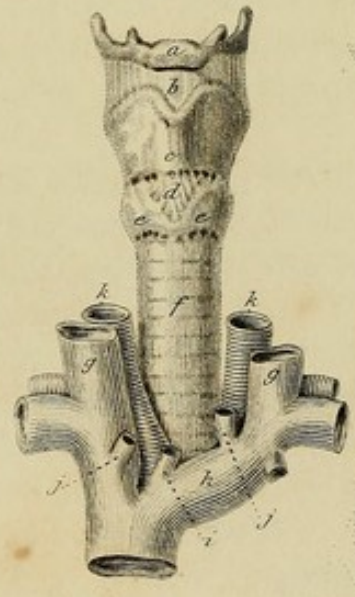


Fig. 4

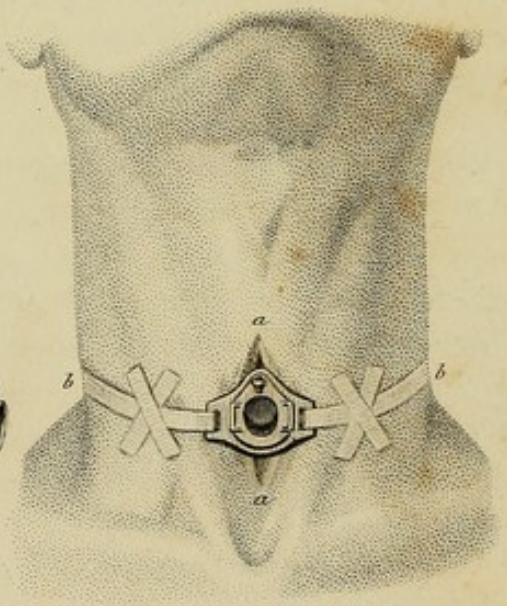


Plate LVI.

BRONCHOTOMY.

Fig. 1, 2 and 3. *Surgical anatomy of the front of the neck.*—Fig. 1. Sub-cutaneous layer of the anterior region of the neck; *a a*, the lower jaw bone; B, os-hyoides; C, thyroid cartilage; *d d*, carotid arteries; *e e*, sub-hyoid muscles; *f f*, internal jugular veins; *g g*, external jugular veins; *h*, sterno-cleido-mastoideus.

The larynx and trachea are covered in front by a layer consisting of the skin and a superficial fascia which envelopes the platysma myoides. Some venous branches of the external jugular traverse this external layer of fascia. The sterno-hyoid and sterno-thyroid muscles, sometimes united along the median line, conceal the larynx and trachea beneath a muscular layer of no great thickness; still deeper, and on a level with the cricoid cartilage, is found the thyroid gland, whose position and dimensions are variable.

Fig. 2. Beneath this superficial layer, we find:—the os-hyoides A: the thyro-hyoid muscles, *c c*, slightly separated at the median line, so as to expose the thyro-hyoid membrane and the projection of the thyroid cartilage, B; the crico-thyroid muscles, *d*; the thyroid gland, E; the trachea F. A dotted line *g g*, indicates the height and direction of the sternum and clavicles. Along the lateral portions of the larynx and trachea the carotid arteries are situated; *h h*, the primitive carotid; *i*, the superior thyroid artery; *j*, the inferior thyroid vessels; *k k*, internal jugular veins; *l*, left vena innominata; *m*, inferior thyroid veins; *n*, arteria innominata.

The inferior thyroid veins, when divided in the operation of tracheotomy, are frequently the source of considerable hemorrhage. To avoid wounding the venæ innominatæ the incision should not be carried too near the sternum; the point of the finger inserted into the wound may feel the pulsation of the innominata and the other large arteries. In treating the subject of tracheotomy, we must draw atten-

tion anew to these anatomical relations, and to the indications which necessarily arise from them in connection with the operation.

Fig. 3. *Anatomy of the larynx.*—*a*, os-hyoides; *b*, thyro-hyoid membrane; *c*, thyroid cartilage; *d*, crico-thyroid membrane; *e e*, cricoid-cartilage; *f*, trachea; *g g*, internal jugular veins; *h*, left vena innominata; *i, j j*, thyroid veins.

Fig. 4. *Operation of tracheotomy.*—*a a*, incision along the median line in front of the trachea; *b b*, a strip of narrow tape, retaining in its proper position a canula which has been introduced into the trachea.

Under the generic title of *bronchotomy*, are included the various operations for making an artificial opening into the larynx or trachea, whether for the purpose of extracting foreign bodies, or for the admission of air when the upper portion of the larynx is obstructed. The incision may be made: 1st, Through the larynx, dividing the thyro-hyoid membrane only (*sub-hyoid laryngotomy*); 2d, Through the thyroid cartilage (*laryngotomy*); 3d, Through the larynx and the first rings of the trachea (*tracheo-laryngotomy*); 4th, Through the trachea (*tracheotomy.*)

INDICATIONS. OPERATIONS.

Bronchotomy is required whenever a patient is threatened with asphyxia by reason of any mechanical obstacle to respiration. This obstacle may be owing to the presence of a foreign body, or to an affection of the respiratory passages.

1st. *Foreign bodies.*—The accidental introduction of foreign bodies into the air passages presents the most ordinary form of accidents for which the operation of bronchotomy is justifiable. These bodies, of every variety in their shape and nature, may produce suffocation, and also occasion ulcerations in the larynx, trachea, or bronchi, which, should they perforate these organs, might give rise to the most dangerous consequences. There is therefore a double indication for the operation, when the foreign body cannot readily be expelled by the efforts of coughing.

Foreign bodies in the œsophagus.—Not only foreign bodies caught in the larynx require bronchotomy; it may happen that hard substances arrested in the æsophagus on a level with the larynx or trachea may compress these organs and occasion an amount of suffocation

which will render the immediate performance of the operation necessary.

2d. *Organic lesions of the air passages.—Abscesses of the throat, or fauces, and inflammation of the tonsils.*—Flajani performed tracheotomy for an inflammatory swelling of the tonsils. But his example should not be imitated in cases where this disease can be relieved by scarifications. This latter treatment therefore should be tried before attempting a more dangerous operation.

Tumefaction of the tongue.—In this affection deep incisions produce a rapid diminution in the size of the organ, and the opinions of Richter and Bell, who advised tracheotomy, have not received the sanction of the profession.

Œdematous Angina.—Lisfranc proposed the scarification of the edges of the glottis by means of the point of a curved bistoury, which should be carried down along the finger to its proper position. But punctures made along the œdematous edge of the glottis do not always allow of the evacuation of a sufficient quantity of serous fluid, and this method, difficult of execution, should not be preferred, in urgent cases, to bronchotomy.* Since the time of Bayle, who first proposed tracheotomy for œdema of the glottis, the operation has been performed with success by a great number of surgeons. Laryngotomy, even, is preferable to the introduction of the laryngeal catheter by the mouth.

Diseases and injuries of the larynx.—Chronic laryngitis, laryngeal phthisis, and wounds of the larynx, may all give rise to suffocation by occasioning a diminution of the calibre of this organ from thickening of its mucous lining. In these different cases, bronchotomy has been performed with success by Velpeau, Senn, Regnoli, Trousseau, and numerous other operators.

Tumours.—If tumours, situated in the larynx itself, or in its imme-

* Since the great improvements effected in the manipulations required for the effectual scarification of the œdematous glottis, by Dr. Gurdon Buck, of the New York Hospital, and the introduction into general use of the admirable instruments which he has invented for this purpose, scarification can be both readily and effectually performed, in so large a proportion of cases of pure œdema of the glottis, that we can confidently recommend its trial, at least, before resorting to bronchotomy. See Dr. Buck's paper on "Œdematous laryngitis successfully treated by scarifications of the glottis and epiglottis" (with plates of the instruments), in the 1st vol. of the Transactions of the American Medical Association.

diate vicinity, give rise to obstructions in respiration, bronchotomy is indicated.

Croup.—Bronchotomy was performed successfully in croup by Severinus and Bartholin, but to Bretonneau the merit is principally due of laying down rules for the operation, and pointing out particularly the indications which require it. Bronchotomy in true croup, by securing at once a free supply of air to the lungs, and allowing the escape or extraction of false membrane from the air passages, not only saves the patient from imminent death, but even in temporarily prolonging life, affords a wider scope to the action of other remedies, and materially increases the chances of a favorable termination, in this fatal disease.

In those cases where the membranous exudation is confined to the larynx, this operation presents the greatest chances of success. When the false membrane extends into the trachea, the operation succeeds less frequently, and it is almost useless when the bronchial tubes have become involved in the disease.

Yet, as it is difficult to determine with certainty the exact extent of the disease, it is advisable, in every case, when asphyxia is imminent, to perform the operation (Bouchut).

SUB-HYOID LARYNGOTOMY.

This operation, first proposed by Malgaigne, but never as yet performed upon the living body, may be useful for the removal of foreign bodies from the glottis, or in cases of severe disease of the larynx.

The fibrous membrane *b* (plate 56, fig. 3), which extends from the os-hyoides *a*, to the thyroid cartilage *c*, is the seat of the operation, and dividing it, we come directly upon the superior orifice of the larynx.

Malgaigne's mode of performing the operation.—Make a transverse incision from an inch and a half to two inches in length, below the os-hyoides, and close to its inferior border. With a second incision, divide the platysma-myoides and the internal half of each of the sterno-hyoid muscles; then carrying the point of the bistoury backward and upward, incise, in the same transverse direction, the hyo-thyroid membrane, and such of its fibres as go to the epiglottis. Seize, with a pair of forceps, the mucous membrane, which each expiration causes to project externally, and divide it, either with a

bistoury, or with scissors; the epiglottis, forced into the wound by the act of expiration, now presents itself; seize it, either with the forceps, or a single hook, and the whole interior of the larynx is laid open to the view, allowing the surgeon to see the proper direction to give his instruments.

THYROID LARYNGOTOMY.

The superficial position of the thyroid cartilage renders this operation very easy. The thyro-aretenoid muscles and the chordæ vocales, which are inserted on the posterior aspect and towards the inferior third of the thyroid cartilage, along the median line, alone require the attention of the surgeon.

Method of operating.—Make an incision along the median line, and extending over the prominence of the thyroid cartilage, from the os-hyoides to the cricoid cartilage; if the isthmus of the thyroid gland prevents the exposure of the crico-thyroid membrane, force it downwards with the handle of the scalpel; separate the sub-hyoid muscles, and after ascertaining the position of the crico-thyroid artery, plunge the bistoury into the membrane which separates the two cartilages. This puncture being made, a probe-pointed bistoury, or a pair of strong scissors, may be used to divide the thyroid cartilage from below upward. This division should be made exactly along the median line, to avoid injuring the insertion of the chordæ vocales. In the adult, the thyroid cartilage is very tough, and it may be necessary to force the blade of the instrument forward with the thumb of the left hand. In aged persons, the cartilage is ossified, and it may be necessary to employ bone forceps or to saw it.

Great caution and dexterity should be employed in seizing the foreign body, lest the manœuvres for its extraction force it into the trachea.

LARYNGO-TRACHEOTOMY.

This operation was successfully performed by Boyer. The incision is carried from the inferior border of the thyroid cartilage to the first rings of the trachea inclusively. The muscles are separated; the thyroid gland is divided, the crico-thyroid artery pushed upward and the bistoury introduced below this artery, divides successively the

crico-thyroid membrane, the cricoid cartilage, and the first rings of the trachea.

The divided edges of the cricoid cartilage remain still strongly in contact, and this circumstance renders the separation of the lips of the wound very difficult. Therefore, in this method of operating, a canula can only be applied below its margin and through the rings of the trachea.

TRACHEOTOMY.

Formerly, to perform the operation of tracheotomy, trochars of various forms, both straight and curved, were used, and these were thrust into the trachea. (See Instruments, plate XI., fig. 2 and 3.)

These instruments, and this method of operating, are now mostly abandoned, and the operation now preferred, consists in making a large opening in the trachea along its median line, in order that canulæ, of appropriate shape and size, can be readily and easily introduced, being found to answer the purpose much better than the canula attached to trochars.

Anatomy.—(See plate 56, and its explanation.)—It should be remembered that the trachea lies deeper, the lower down we go; that the arteria innominata crosses it on a level with the top of the sternum, and that in cases where the operation is performed for the extraction of foreign bodies, or for croup, the soft parts may be infiltrated—with serous fluid, or with gas.

The instrumental apparatus, if it be a case of croup, and artificial respiration is deemed necessary, consists: 1st, Of an ordinary scalpel, a sharp-pointed, and a probe-pointed bistoury; 2d, A pair of dissecting forceps; 3d, Blunt hooks, with which the assistants separate the lips of the wound; 4th, Dilating forceps (plate XI., fig. 11), or a dilator (fig. 13); 5th, Simple or double canulæ (fig. 5, 6, or 7 and 8), which can be introduced by means of a stylet (fig. 10; a hair swab (fig. 4), to clean the canulæ; and sponges (fig. 12), to clean the trachea. For the extraction of foreign bodies, a pair of long curved forceps is required to seize the foreign body, whether it be situated above or below the incision.

Method of operating.—We give below the detailed description of the operation by Professor Trousseau.

"The child is laid upon a table, with a round pillow placed under

the nape of the neck, so as to produce a decided projection forward of the anterior portion of the throat, a very essential circumstance; the surgeon, aided by at least three assistants, rapidly incises the skin, and then pursues his dissection slowly to the trachea, exposing several of its rings. He now makes a large vertical opening in the trachea, avoiding if possible any injury to the veins; if these cannot be avoided, he cuts them freely, and continues the operation without tying them, the hemorrhage always ceasing when the canula is introduced into the trachea.

"As soon as the trachea is opened, the two branches of the dilater must be inserted between the lips of the wound, and the child immediately raised up and allowed to rest for some minutes until respiration is completely established, and the hemorrhage arrested.

"If, in spite of the opening into the trachea, the child remains in a state of asphyxia or syncope, cold water must be dashed in its face, and the feathered extremity of a quill introduced into the trachea to provoke the contraction of the inspiratory muscles.

"If there be orthopnœa, a few drops of cold water must be injected into the trachea, and a swab, consisting of a small sponge fastened to the extremity of a very flexible piece of whalebone (plate XI., fig. 12), carried rapidly up and down through the passage. The object of this manœuvre, which may be done once, or several times if necessary, is to aid in the expulsion of blood, or false membranes, which may be present in the trachea or bronchia.

"As I have advised that the veins should be avoided, if possible, and never tied, I ought to justify in a few words the practice, which Bretonneau and myself have always followed.

"If we incise slowly and successively the tissues which lie between the skin and the trachea, we see that at every inspiration the thyroid veins swell in the wound. When they are situated on each side of the incision made by the scalpel, we proceed without regarding them; but if they are found along the central line of the incision, they can, without difficulty, be drawn aside with blunt hooks.

"Sometimes, however, the thyroid veins of the two sides anastomose with each other, and form a series of transverse branches crossing directly in front of the trachea; in this case they must of necessity be divided. A considerable hemorrhage usually follows their division, and this can generally be arrested by pressure made with the point of the finger, on one side by the operator, and on the other by an

assistant. Then continuing the incision, using the nail of the index finger buried in the wound as a guide, and employing the sponge frequently, we soon bring the trachea into view, which being rapidly divided, and the dilater introduced, the hemorrhage is instantly arrested.

"I give it, then, as a precept, that the veins should not be tied, because, having already performed the operation of tracheotomy one hundred and twenty-one times (June 1st, 1842), I have never found it necessary to tie them; and also, because Bretonneau, Berard the younger, and Guersant, junior, who have frequently performed this operation, never have employed the ligature. Besides, ligation might give rise to ill effects; in the first place, it is liable to be followed by phlebitis, a dangerous disease in this region of the body; and in the second place, it would necessarily prolong an operation, which is frequently performed under circumstances where the greatest expedition is necessary.

"*Accidents during the operation.*—The unfortunate occurrences which may present themselves during the operation are: 1st, *Hemorrhage.* As we have already remarked, hemorrhage is rare, and usually of little importance. If a considerable number of the thyroid veins have been cut, and the blood escapes in quantities, the trachea should be held firmly between the index and middle fingers, thrust deep into the wound, and then divided rapidly from below upward, and the dilater instantly introduced; the hemorrhage will then cease of itself. I do not refer to hemorrhage which would follow a wound of one of the thyroid arteries, or of the arteria innominata, because in such case, it would be absolutely imperative upon the surgeon to tie these vessels before concluding the operation. I am not aware that such a misfortune has ever happened; but I have frequently with the point of the index finger felt the pulsation of the innominata, which I should certainly have wounded, had I incautiously used the scalpel in the inferior commissure of the wound.

"I have frequently seen asphyxia, and the cessation of respiration during the operation; the patient was apparently dead. In these cases, I concluded the operation as quickly as possible, and introduced the canula; then, placing the patient on the side, if blood ran into the trachea, but otherwise upon the back, I attempted artificial respiration by alternate pressure and relaxation of the chest and abdomen, and in every case I have succeeded in effecting restoration.

"*Syncope* is a much more common accident, and usually occurs immediately after the operation, at the moment when, respiration becoming free, the cerebral congestion suddenly ceases; on one occasion I have seen it last for an hour, but it has never been fatal. My treatment, in such cases, is to have the patient laid flat on the back, to pour cold water upon the face, and to inject a few drops of it into the trachea, at the same time swabbing it rapidly up and down.

"A great deal has been said regarding the introduction of blood into the trachea; I have never seen this accident prove serious, provided a dilater was introduced immediately, by which the lips of the tracheal wound can always be kept well separated; or rather, if a large canula could be inserted at once without loss of time. If the surgeon, after dividing the trachea, fails to insert the canula, the blood is sucked into the trachea at every inspiration, and as the air cannot penetrate at the same time, on account of the valve-like approximation of the edges of the wound, an almost immediate asphyxia may be the consequence; in addition to this, the hemorrhage continues mainly or entirely in consequence of the embarrassment of the respiration.

"But if, on the contrary, the wound in the trachea is kept open by means of a dilater, the air readily penetrates and forces out the small quantity of blood which has been drawn in, and normal respiration returning, the hemorrhage is permanently arrested. If, however, a small quantity of blood still finds its way into the bronchial tubes, the efforts of the patient are usually sufficient to expel it; but if there should be any difficulty, a few swabbings will suffice to effect its expulsion.

"Respiration usually becomes very easy immediately after the operation. Should evidences of obstruction still continue, they arise from the presence of clots of blood, or false membranes filling up the principal bronchial tubes. If the presence of clots of blood is suspected, one or two instillations of cold water into the bronchi, and the subsequent introduction of the sponge and whalebone, while the trachea is held open by means of the dilater, or even after the introduction of the canula, will suffice for their removal.

"When there are false membranes in the trachea, the dilater should be left in the wound until they are expelled, which can be facilitated, first, by the instillation of cold water into the bronchi, and then by repeated swabbings. Sometimes, however, in spite of these means,

the false membranes remain fixed by their inferior attachments, while the upper portions are broken up and loose. Occasionally, in these cases, by seizing them with a pair of forceps introduced through the wound and exercising slight traction, their removal may be accomplished.

"If the child be vigorous, and has energetically expelled the false membranes from the air passages, and respiration be very free after the operation, before introducing the canula, the surgeon may inject into the trachea fifteen or twenty drops of a solution of nitrate of silver (five grains to the ounce of distilled water), and may repeat this after a short interval; if he has, however, good reason to believe that the larynx alone is the seat of the disease, he may introduce a sponge into the trachea, previously charged with a very strong solution of nitrate of silver (ninety grains to the ounce of distilled water).

"The canula must then be introduced. But in children, operated upon in the last stages of croup, the canula must be inserted immediately, and the surgeon should content himself with the injection of a few drops of cold water, and rapid swabbings, having recourse to caustic applications after a proper delay.

"*Canulæ.*—The open curved canula of Bretonneau (plate XI., fig. 8), or the split canula of Gendron (fig. 9), appear to me to be preferable to all others; but for large children and adults, the double concentric canula should be used. The canula should be long enough to extend into the trachea at least two-thirds of an inch. This condition is indispensable, for the second day after the operation the tumefaction of the skin and the divided tissues will be so great that it will scarcely allow the canula to penetrate more than two or three lines. If the canula be too short, it will be forced out of the trachea by the efforts of coughing, and the child may become asphyxiated.

"If it be essential to have a long canula, it is still more important to have one which is large enough. For children from six months to two years of age, the diameter of the tracheal opening of the canula should be two lines and a half; from two to four years, three lines; from four to six years, three lines and a half; from six to ten years, four lines; up to adult age, four lines and a half; and finally, for men of very large size, an inch, and even more, in diameter.

"The canula should be withdrawn whenever respiration becomes embarrassed, provided there is reason to suppose that this embarrass-

ment is owing to the instrument. It is usually sufficient to change the canula twice in twenty-four hours. The abundant discharge of mucus, or the expulsion of false membrane which obstructs the passage, may require a more frequent withdrawal of the instrument.

"When instead of a simple, a double canula is used (fig. 5), the interior tube should be drawn out every three hours and replaced again as soon as possible; this manœuvre is executed without the patient's knowledge, and extraordinary causes excepted, renders the complete stoppage of the artificial passage impossible.

"During the first two or three days after the operation, when the canula is removed, the opening into the trachea closes so rapidly and completely as to produce symptoms of asphyxia within the space of a few minutes; it is therefore necessary to insert another canula or the dilater immediately, and the dilater is even very useful in the manœuvre of changing the canula, for it prevents the patient from being subjected to severe pain, and repeated efforts.

"The interval after the canula has been withdrawn, and whilst the lips of the wound in the trachea are kept separate by means of the dilater, should be chosen as the proper time for the application of caustic solutions to the mucous membrane within, and for the use of the sponge.

"After a few days, the wound in the trachea will remain open of itself for a few moments after the removal of the canula, which can then be easily replaced without the aid of the dilater. Towards the eighth day, the wound in the trachea will frequently remain open for an hour, and still later it may remain patent for an entire day or even longer.

"After the fourth or fifth day, should the patient appear to be progressing favorably, there will be no danger in allowing the canula to become clogged a little occasionally, in order that the air, impinging upon the larynx in the consequent efforts to resume normal respiration, may dislodge any collections of mucus and false membrane, and thus open a free passage for itself through this organ. By this means the extent of the permeability of the larynx can also be determined. This is the more important, as one of the first principles in tracheotomy is to do away with the use of the canula as soon as possible.

"If a small quantity of air passes through the larynx, a new canula may be introduced, whose external orifice is closed by the insertion of a small plug of adhesive plaster or cork.

"During the first few minutes after this corked canula has been introduced, respiration may seem to be easy, when the quantity of air introduced is, in reality, insufficient; but, little by little, respiration becomes labored, and the child would die of asphyxia were not the plug removed, which prevents the entrance of air. But if the breathing continues only moderately oppressed, the plug may be allowed to remain in the canula, when the efforts of coughing, by forcing the expired air and the accumulated mucus against the opening of the glottis, detaches the false membrane, and the passage becomes much more free. From day to day the calibre of the canula should be gradually diminished, and when the patient breathes freely with the opening entirely closed, the instrument may be dispensed with altogether.

"When the canula is finally removed, the lips of the wound are to be brought together with sticking plaster. This dressing, which should be renewed two or three times a day, answers the purpose in the great majority of cases. The wound in the trachea usually heals in a few days. The remaining tissues, in general heal readily and with but little deformity.

"On one occasion I removed the canula at the end of the fourth day; in a few others from the sixth to the eighth; but in the majority of cases, from the sixth to the thirteenth day; in one instance, I allowed it to remain until the forty-second, and in another, until the fifty-third day. When no accident happens, free action of the larynx is established from the fourth to the thirteenth day.

"I have never yet seen a permanent fistula after the operation of tracheotomy.

"*Treatment after the operation.*—For some physicians, there is but one indication in the case of a child in the last stages of croup, and that is the operation of tracheotomy—for the sole purpose of introducing a canula. But I look upon tracheotomy, in the first place, as a means of alleviating imminent asphyxia, which would destroy the patient, and secondly, to permit the application to the mucous membrane of the trachea and bronchial tubes, of medicinal remedies which may prevent the reproduction or extension of false membrane. I know that many of my professional brethren have been fortunate in the operation of tracheotomy, contenting themselves with frequent changing of the canula and the occasional swabbing of the throat; but for my own part, I have been desirous of ascertaining what was

the real value of topical applications in these cases. I have performed tracheotomy on twenty children consecutively, without applying caustic solutions to the mucous membrane, and the results were so deplorable, that I have returned to the use of topical applications with greater faith than before.

"I employ the following solution, which is the same as that used by Bretonneau (of Tours) :—

"As aforesaid, if the child be vigorous, and has energetically expelled the false membranes contained in the air passages, and if, after the operation, the respiration be easy, before introducing the canula, I inject into the trachea, two or three times, after short intervals, fifteen or twenty drops of a solution of nitrate of silver, five grains to the ounce of distilled water. This injection should be repeated four times the first day; three times the second, and third day; and once or twice the fourth day, after which it may be dropped altogether.

"In concurrence with this, a swab, made with a very small sponge fastened to the extremity of an extremely flexible piece of whalebone, and dipped into a concentrated solution of the nitrate of silver (ninety grains to the ounce of distilled water), may be carried up and down through the trachea.

"The surgeon should be contented with the latter treatment, if there be reason to suppose that the larynx alone has been attacked. Cauterization with the sponge should be made as frequently, and continued as long, as the caustic injections are employed.

"Injections of simple water, and swabbings with a moist sponge, also occupy an important place in the treatment.

"If the cough is loose, and expectoration easy, the water injections may be dispensed with. But if the opposite be the case, eight or ten drops of warm water may be injected once or twice an hour, which will mix with, soften, and aid in the expectoration of the collections of mucus.

"Water should always be injected after the introduction into the trachea of the solution of the nitrate of silver, in order to dissolve the mucus which may have been coagulated, and facilitate its expectoration. It may be necessary to inject water a number of times every hour; when the respiration is frequent and *sawing*, that is simulating the sound which a saw makes when sawing stone, it would be proper to do so immediately after every swabbing.

"Swabbing should be adopted whenever the canula or trachea appear to be obstructed. This swabbing will be rendered more efficacious by the previous injection of water. If a valvular sound, or a peculiar wheezing, is heard in the trachea, which give rise to the belief that floating false membranes are present, swabbing should be frequently performed in order that these floating false membranes may be expelled. The moment when the canula is withdrawn, and the edges of the wound separated by the dilater, is the most proper time for swabbing. The more grave the symptoms which follow the operation, the greater the necessity for swabbing. It is never productive of injury, and is always followed by a great calmness of breathing, even when children are almost dead, and the sponge neither brings out mucus nor false membrane.

"With these means of treatment, which are carefully employed by Bretonneau and myself, the success has not been very brilliant; but Bretonneau, in twenty operations, has saved six children, and in one hundred and twelve cases, I have saved twenty-seven. Leclerc (of Tours), who has adopted the same treatment, has been successful in two cases. Velpeau, a pupil of Bretonneau, as well as myself, has cured two children out of ten cases. Petel (of Cateau Cambresis), with the same treatment, has performed six operations, three of which were successful. Thus, in one hundred and fifty operations, thirty-nine have been successful, that is to say, a little more than one-fourth. I regret that I cannot give here the results obtained by many other of our professional brethren who have followed the same system of therapeutics as Bretonneau and myself, nor of those who have contented themselves with the insertion of a canula, and the injection of water. A comparison of these results would have been interesting, but the materials are entirely wanting. We are well aware, that there are now living in Paris some fifteen children on whom the operation of tracheotomy has been performed in the last stages of croup, by Gerdy, Robert, Guersant, the younger, Boniface, Desprès, Blandin, and others, in whose cases our method of practice has not been followed."

Pl. 57.

Fig. 1.

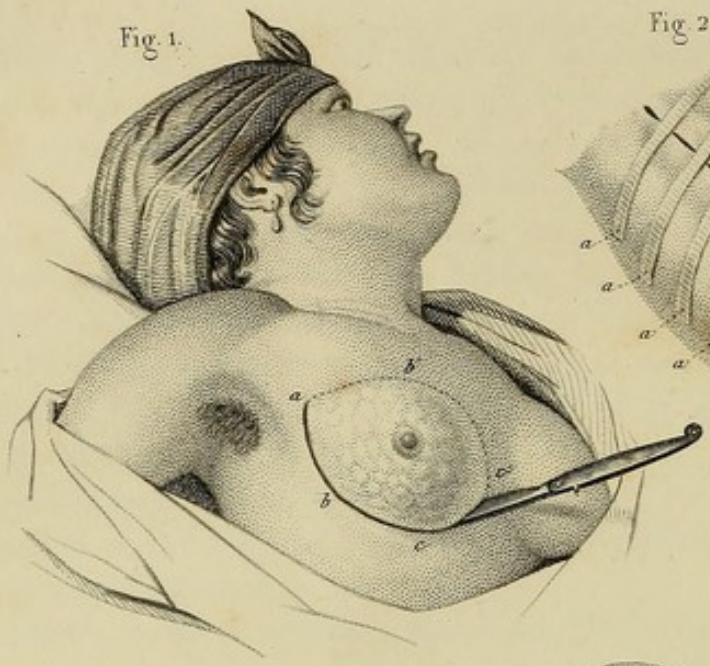


Fig. 2.

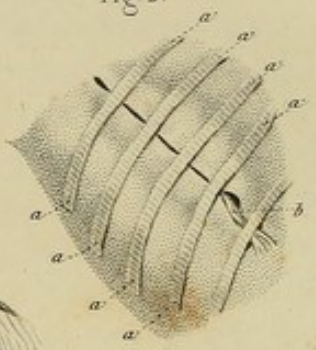


Fig. 3.

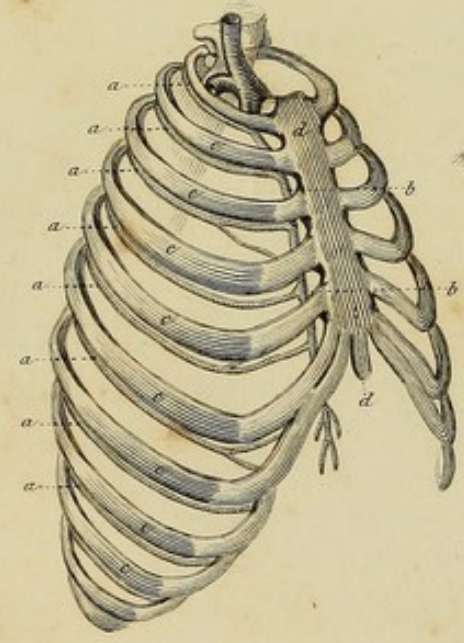


Fig. 4.

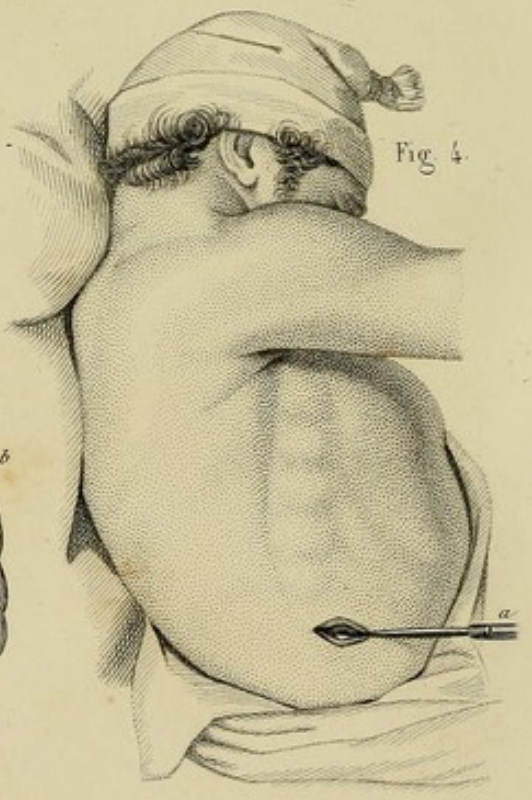


Plate LVII.

EXTIRPATION OF THE BREAST—EMPYEMA.

Fig. 1. *Amputation of the breast.*—*a b c*, first curvilinear incision made at the base of a cancerous breast; *c' b' a*, second incision, comprising, with the first, the tumour in an elliptical mass.

Fig. 2. *Dressing after the operation.*—*a a'*, *a a'*, etc., strips of adhesive plaster, holding the edges of the wound together. Points of interrupted suture occupy the intervals between them. A piece of lint *b*, is inserted into a dependent point of the wound to facilitate the escape of pus.

Fig. 3. *Anatomy of the ribs and the intercostal arteries.*—The intercostal arteries divide into two branches on a level with the posterior third of the ribs. The superior branch, which is larger than the inferior, runs along the deep furrow of the upper rib, and leaves the bone altogether, at about its anterior third. The inferior branch runs along the superior border of the rib below.

Fig. 4. *Operation for Empyema.—Sedillot's method.*

EXTIRPATION OF THE BREAST.

Extirpation of the breast is most frequently performed for the removal of schirrous or encephaloid tumours. A great many surgeons have condemned the operation for this purpose on account of the frequent reappearance of this form of disease. Yet all tumours which are developed in the breast are not liable to return, their diagnosis is never absolutely certain, and the numerous instances in which tumours, recognised as cancers, have been removed without return, is a strong argument in favor of the operation in a majority of cases where the disease presents itself under conditions at all favorable to success. These conditions are: the mobility of the tumour; its well circumscribed form; the age, strength, and good general health of the patient. Large tumours, adherent to the ribs, and extending into the

axilla, with enlargement of the axillary and cervical ganglions, the yellow straw-colored tinge of the skin, characteristic of the cancerous diathesis, the existence of tumours in any other part of the body, symptoms of a general infection, are all counter indications. But, adhesion to the ribs alone, without the other complications which we have enumerated, should not prevent the performance of the operation. The only chance of a permanent cure of the patient depends upon the performance of the operation when there is every probability that the disease is purely local.

Modes of operating.—In honor to Recamier we simply refer to compression, which has been condemned by Sir Charles Bell. At the present time most practitioners regard this remedy as useless in the treatment of cancerous tumours, and consider that its repeated success was probably due only to errors of diagnosis.

Ordinary method of operating.—The instruments consist of straight and convex bistouries, dissecting forceps, hooks, ligature forceps, waxed threads, rasps and exsecting saws; some cauterizing irons may be useful in case the disease has attacked the ribs.

The patient reclines upon an inclined plane, and upon the side opposite to the diseased breast; the arm is carried away from the body, so as to put the fibres of the pectoralis major muscle upon the stretch; the surgeon takes his position upon the diseased side, and the necessary assistants take their places around the patient in such situations as to render the most intelligent assistance to the operator.

Two semi-elliptical incisions, one inferior, with its concavity looking upwards, and the other superior, with its concavity looking downwards, should comprise in an elliptical mass all of the diseased as well as a portion of the healthy tissues. These incisions should be carried from above downwards, and from without inwards, in the direction of the large diameter of the gland, and the fibres of the pectoralis major. This direction, which readily allows the prolongation of the incisions into the axilla, facilitates the investigation which ought to extend to this region. Besides, it permits the dissection of the tumour in a line with the fibres of the pectoral muscle, and after the flaps are brought together, liquids readily escape from the inferior portion of the wound.

The tumour is then seized either with the fingers, or if it be large by a hook, which is held by an assistant, and the operator dissects it up, first from below upwards, and then from above downwards, taking

care to remove at the same time a portion of the sound tissues. By commencing the dissection at the inferior portion of the tumour, the surgeon avoids the annoyance which would be occasioned by the flow of blood from above, in case the operation were commenced superiorly. Yet some surgeons prefer to commence their dissection from above downwards, lest they should carry their incisions below the pectoral muscle. When the tumour is very large, the incisions should be made successively above and below, so as to isolate it gradually from its periphery towards the centre of its base.

When the tumour is removed, the arteries tied, and the wound well sponged, the surgeon should proceed to the examination of the subjacent tissues. All the parts which appear to be altered should be removed, either with the scalpel, or a pair of curved scissors. Any suspected glands should be exposed by prolonging the incision towards the axilla, and as it might be dangerous to dissect them out from the axilla, or the vicinity of the large vessels, it is prudent to lay them completely bare and then to tear them away with the fingers. These little diseased glands are usually found on a level with the thoracic vessels, below upon the serratus magnus, and above beneath the pectoralis minor. (For the surgical anatomy of the axilla, see page 25, and plate 9.)

It is not necessary to proceed immediately to the dressing after the termination of the operation; it is prudent to wait some time before bringing the flaps together, to watch the minute arterial branches which have not been tied, in order that the wound may be finally closed without the risk of hemorrhage. An attempt should be made to heal the wound by the first intention, by bringing the flaps together and securing them by points of suture (see sutures, page 6, and plate 2, fig. 6). If the wound be small, and the flaps easily brought together, they may be retained in proper position by means of long strips of adhesive plaster, separated from each other by about the third of an inch interval, and crossing the wound at right angles (plate 57, fig. 2). In cases where there is difficulty in bringing the edges of the wound together, the flaps must be dissected up to a proper distance, in order to detach them from the subjacent parts and render them more extensible.

EMPYEMA, FIGURES 3 AND 4.

The term paracentesis thoracis is given to the operation which is performed for the purpose of evacuating from the cavity of the chest any liquid accumulations, whether of pus, blood, or serum. In health, the lungs fill up the whole of the thoracic cavity; but when an effusion takes place in the chest it is located in the cavity of the pleuræ, and involves contraction of the lungs. The presence of these fluids in either of the pleural cavities, constitutes the disease called empyema. This effusion may be large enough to compress the pulmonary tissue, and thus embarrass respiration. We have said above that blood, pus, serum, and even gas, may be effused into the pleuræ, and demand the operation for empyema. The nature of the liquid effused, its quantity, the situation which it occupies, the various complications to which it gives rise, constitute so many operative indications which require the puncture to be made, either in the *place of election*, or in the *place of necessity*. (See below.)

Effusion of blood.—If the effusion of blood is owing to a traumatic lesion, there should be no haste in evacuating the liquid, as its presence tends to obliterate the bleeding vessel, and thus to arrest the hemorrhage at its source. Care should be taken to place the patient in a proper position, to close the wound through which the hemorrhage has taken place, and, by appropriate general treatment, to prevent the further flow of blood. A counter-opening to give exit to the effused blood should only be made after the lapse of several days. But, when the suddenness and quantity of the effusion threaten immediate suffocation, the operation may be required at once.

Effusion of pus.—The operation is here required where purulent effusion follows an acute or chronic affection of the lungs, or pleuræ. But if there is evidence of the existence of tubercles or excavations in the lungs; if the exhaustion of the patient, or the nature of the disease which produced the effusion leaves no hope of cure, the operation is contra-indicated, except as a desperate resource, and to prevent suffocation. Purulent effusions may terminate naturally: 1st, By absorption; 2d, By ulceration of the pulmonary tissue, and the discharge of pus by the bronchial tubes, the trachea, and the mouth; 3d, Finally, the ulcerated thoracic parietes may allow the pus to escape externally.

Effusion of serum.—The operation of paracentesis offers the great-

est prospects of success if performed after acute pleuritis, terminating by effusion of serum, when the effusion remains and threatens suffocation, although all inflammatory symptoms may have subsided. It would be imprudent to operate in the first stages of pleurisy, or when the disease is still in an acute stage. The operation should not be performed in chronic pleurisies where the effusion has existed for a long time, and the lung forced back upon itself is incapable of regaining its former elasticity.

Effusion of gas.—The air, or gas, which escapes into the pleuræ when the cause of these effusions is slight, is absorbed with so much facility, that it is unnecessary to have recourse to any operation. If the cause of the effusion be serious, an operation is contra-indicated. We have referred to effusions of gas solely for the sake of enumerating them.*

MODES OF OPERATING.

According to Galen, the Greeks perforated the chest with a red hot iron; this method may have been the one employed by Paulus Æginetus. The operation of paracentesis, sometimes performed by cauterisation, at others by incision in the intercostal spaces, or by trephining of the ribs, was followed at various epochs by different results, generally unfavorable, and after having been at one time abandoned, and at another resumed, was finally reduced to a system by Dionis, Ledran, Foubert, and Morand.

* The conditions requiring the operation of paracentesis thoracis are of necessity imperfectly detailed in the text; their exact appreciation belongs rather to the pure physician and practised auscultator, than to the operating surgeon, and yet it is a resource capable of affording much relief, and perhaps too often overlooked. Its danger as an operation, like that of tracheotomy, is apt to be overrated by physicians. This, when judiciously performed, is not great, and the relief which follows it is to the patient inexpressible. In pleurisy, terminating by serous, or sero-purulent effusion, nature, generally, assisted by judicious medical treatment, slowly removes the fluid; but, if absorption is delayed beyond a certain period, the lung is liable to become permanently bound down by adhesions, and thus hopelessly thrown out of use; here paracentesis might be judiciously interposed with decided advantage. In serous effusion into the pleural cavities, arising from the pressure of enlarged bronchial glands, or thoracic aneurism, upon the great veins of the posterior mediastinum, we have seen distressing dyspnœa successfully relieved by the operation of paracentesis, in the practice of Dr. John T. Metcalfe, of this city.—Ed.

Numerous facts, furnished by the practice of surgeons at the pre sent day, show that about half their cases have terminated success fully. This result appears to us favorable enough to justify the performance of the operation of paracentesis in cases which indicate its necessity.

Should the entire effusion be evacuated at once, by a large outlet, or should the surgeon *proceed cautiously, and by successive punctures allow the liquid to escape slowly and gradually?* We have not room for the various arguments on either side of this much-debated question. Modern surgeons, and particularly Reybard, whose method we give at length, have abundantly pointed out the advantages of the second method.

Place of election.—As a rule, the puncture should be made at a depending point towards the base of the chest, and where there are no adhesions. The 7th, 8th, or 9th intercostal space is to be preferred; if the puncture were made lower down there would be danger of wounding the diaphragm. In thin persons, whose ribs can be readily felt and counted, there is no difficulty in determining upon the point for the incision. But if the patient be too fat to allow of the distinct recognition of the intercostal spaces, the puncture may be made five fingers' breadth below the inferior angle of the scapula, or rather three fingers' breadth above the cartilaginous border of the ribs.

The opening should be made on the back part of the chest, about at the junction of the posterior with the two anterior thirds of its semi-circumference, and in front of the margin of the latissimus dorsi muscle.

Place of necessity.—By this term is meant a bulging or prominence, caused by an evident disposition of the confined fluid to evacuate itself, and the centre of this prominence, when it exists, is always chosen by the surgeon as the seat of his operation.

Sedillot's method.—Sedillot rejects all methods in which several successive incisions or punctures are made with the object of securing a valve-like opening, and the subsequent immediate re-union of the wound, and advises that the opening should be made at once, large enough to give free exit to the contained fluid, and that it should be prevented from closing subsequently, by the introduction of some foreign body.

For this purpose, he makes an incision in the skin some two inches

in length, either at the place of election, or that of necessity. The deep parts are divided layer upon layer, and to a less extent. When the effusion is moderate and circumscribed by pulmonary adhesions, or when the walls of the abscess easily collapse and come in contact with each other, there is no danger in complete evacuation. But in cases where the collection occupies the whole of the pleural cavity, and is very abundant, the escape of the liquid should be arrested as soon as it begins to flow in jets at each inspiration, and there is danger of air penetrating into the chest. This phenomenon shows that the pus no longer suffices to fill up the thoracic cavity, at the moment of its dilatation, and that a vacuum is about being produced. A piece of fine linen should then be placed in the wound, in whose hollow a roll of lint is inserted; some layers of lint, a thick compress, and a bandage accurately adjusted around the thorax, complete the dressing.

Two hours after the operation, the pus may again be allowed to escape; and this may be repeated as often as necessary, at about the same interval of time. Occasionally a small quantity of air penetrates the chest during the removal of the dressing, but this need not give rise to any special alarm, unless it should take place during the interval. Should the effused pus escape and its place be occupied by air which has effected an entrance either from a want of proper caution or from any other cause, the latter can be removed by using Stanski's air pump, or any other exhausting syringe; an injection of barley water may then be made into the chest, which should be allowed to remain until the next dressing.

Velpeau's method.—Whenever a collection of blood or any other fluid in the chest has given rise to a projection of the integuments in the intercostal spaces, Velpeau boldly plunges a bistoury into the pleural cavity, and enlarges the wound when withdrawing the instrument.

When the diagnosis is certain, this method offers an advantage in the fact that a large opening gives rapid exit to the effused fluid, while a narrow wound might allow the entrance of air without fully evacuating the pleural cavity.

Method of Vidal de Cassis.—Vidal advises the performance of the operation in the following manner:—He commences by an incision which involves successively the skin, the subjacent cellular layer, and the muscles, including the external intercostal; having thus laid

bare the internal intercostal muscle, he dresses the wound in with lint, and waits several days, until suppuration has taken place. He now inserts a piece of caustic potash into the wound, large enough to produce an eschar the size of a dime; this gradually destroys the remaining layer of the thoracic wall, and as it detaches itself, a slight trickling of the effused liquid will commence, which, as the opening enlarges in size, gradually and regularly increases, so that the lungs and the parietes of the chest will have time to approximate each other and thus fill up the space previously occupied by the effusion. The introduction of air into the lung will thus be progressive, and but very little if any will find its way into the pleura through the opening in the thorax.

Reybard's method.—This simple and ingenious method permits a continual flow of the effused liquids without allowing the ingress of air into the pleural cavity.

Reybard perforates the walls of the chest with a trochar, and inserts a canula or the barrel of a quill into the opening, which is permanently retained. The free extremity of the canula is furnished with a nipple made from the intestine of a cat, or with a tube of well soaked goldbeaters' skin; the result is, that the effused fluid easily escapes externally at each inspiration, and at each expiration the soft walls of the tube of goldbeaters' skin collapse and close the extremity of the canula, thus preventing the air from entering the chest. Trousseau plunges the free extremity of the apparatus into a vessel filled with water, which renders the introduction of air impossible.

Stanski's method.—Paracentesis, with the cupping-glass and exhausting syringe.—Stanski considers that the most essential indications in the operation are: to obliterate the abscess, to prevent the entrance of air into the thoracic cavity, and to dry up the source of the secretion. To effect these results, this operator uses an apparatus consisting of a cupping-glass attached to the trochar, in which a vacuum is produced by means of an air pump. By suction alone he thus withdraws the fluid from the chest, and the external air penetrating the lung, dilates this organ, and thus brings the two pleural membranes in contact. This operation has as yet (1849) only been performed upon the dead body.

Summing up.—The pathological considerations which preceded the description of these methods of operating for empyema will indicate sufficiently the relative value of each of them. Effusions of serum

may require small punctures, by which the slow and progressive discharge of the fluid can be safely secured. Effusions of coagulated blood, or of pus, require larger openings. Finally, the quantity of the effusion, the general condition of the patient, the amount of dyspnœa present, etc., etc., must suggest to the operator the adoption of methods which are of slow or rapid execution.

PARACENTESIS OF THE PERICARDIUM.

This is a dangerous operation and very rarely required. In cases where the operation is demanded, the surgeon can penetrate the pericardium by one of the three following directions: 1st, Through the sixth intercostal space; 2d, Through the sternum; 3d, In the space which lies between the xiphoid appendix and the cartilage of the seventh rib.

1st. *Desault's method.*—This surgeon made an incision between the sixth and seventh ribs of the left side, on a level with the apex of the heart. The muscles were divided layer by layer, and the finger of the operator thrust into the wound, felt a pouch filled with liquid. It was opened; but at the autopsy, made some four days afterwards, it was discovered that this was a cyst lying directly upon the pericardium.

2d. *Skielderup's method.*—This consists in trepanning the sternum over the anterior mediastinum. We thus come down upon a triangular interval, whose base is formed by the diaphragm, and whose apex is on a level with the fifth rib. Trepanning of the sternum is performed without any great resistance until the internal periosteum is reached, whose extreme density serves as a warning to the surgeon, who then proceeds very cautiously to avoid lacerating the pleura. The opening being made, the patient should be made to lean forward, so that the projecting pericardium will come readily in contact with the finger of the operator. A straight bistoury guided by the index finger should then be used to open the pouch.

3d. *Larrey's method.*—The most depending portion of the pericardium may be reached by traversing from below upward, the space which separates the left border of the xiphoid appendix from the cartilage of the last true rib. By this method, which is preferable to the two former, the surgeon readily avoids wounding the pleura, peritoneum, and diaphragm, as well as the internal mammary artery.

LESIONS OF THE INTERCOSTAL ARTERIES.

Wounds in the posterior third of the chest only are likely to seriously injure the intercostal arteries. When the wounded artery can be seen it must be tied. The modes of operating, other than ligature, which have been proposed to prevent hemorrhage in these cases, are more numerous than the cases on record of wounds of the intercostal arteries themselves. The true source of the hemorrhage should be first ascertained before having recourse to any method whatever. The introduction into the wound of a card, bent into the form of a gutter, has been proposed. If the blood escapes underneath the card, it proves that the lung has been wounded; but if the blood runs out upon the card, an intercostal artery is the source of the hemorrhage.

If there be an evident injury of the artery, the finger covered with a compress, shaped like the finger of a glove, should be inserted into the wound; this sac should then be stuffed with lint until it forms a sort of cushion against the pleura. By partially withdrawing this little apparatus, we compress not only the borders of the wound, but also the intercostal artery against the groove of the rib.

We will not here describe the various instruments which have been invented to accomplish this same purpose. They are all more or less inapplicable, and always irritating to the pleura.

Plate LVIII.

OPERATIONS UPON THE ABDOMEN.

PARACENTESIS ABDOMINIS.

Surgical anatomy, fig. 1 *and* 2.—French surgeons, in performing the operation of paracentesis, usually introduce the trochar somewhere along the line *a c*, fig. 1, which extends from the umbilicus to the anterior superior spinous process of the ilium on the left side. By performing the operation in this locality, the surgeon avoids the fleshy portions of the abdominal walls and also escapes wounding the epigastric artery, *b*, fig. 2, which lies beneath the rectus abdominis. English surgeons perform the operation in the course of the linea alba, *a b*, fig. 1.

The object of this operation is to evacuate fluids which have accumulated within the cavity of the peritoneum. It is usually performed for ascites; this disease may be complicated with, 1st, Pregnancy; 2d, An ovarian cyst; 3d, By septa, constitututing an encysted dropsy; 4th, By a congenital hydrocele. These various complications may furnish indications to the surgeon, by which he can determine upon the most appropriate locality for the performance of the operation. When pregnancy is present, particular care should be taken to avoid injuring the uterus. With this object in view, Scarpa proposed making the puncture in the left hypochondrium, a little below the third false rib. Ollivier d'Angers suggested the umbilicus as an appropriate locality. Velpeau thinks the operation can be performed without danger anywhere in the left flank. The operator should take into consideration the date of the pregnancy, the direction of the body of the uterus, etc., in determining upon the mode to be adopted. In congenital hydrocele, Morand and Ledran punctured the hydrocele itself. In encysted dropsy and doubtful cases, the fluctuation and prominence produced by the fluid will indicate the point to be chosen for the performance of the operation.

Usual method.—Puncturè with the trochar.—The instrumental

Pl. 58.

Fig. 1.

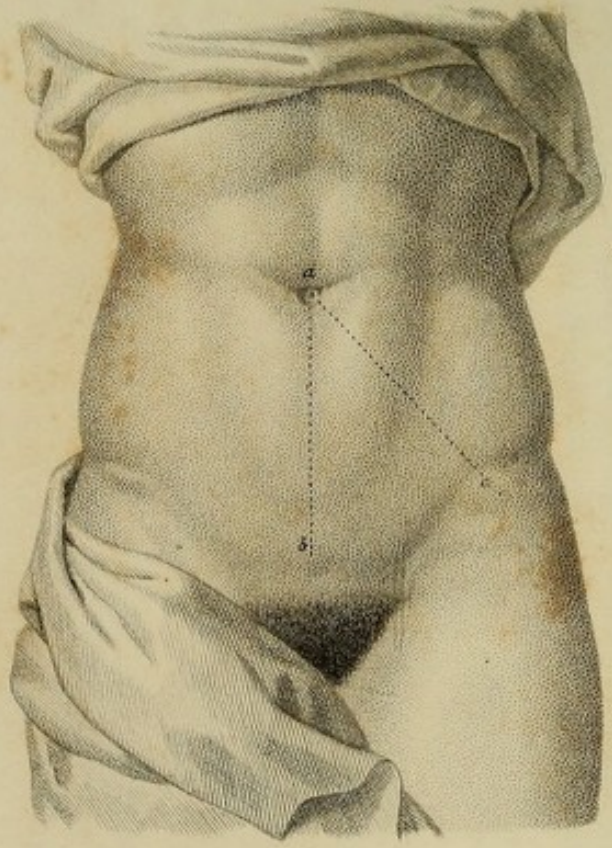
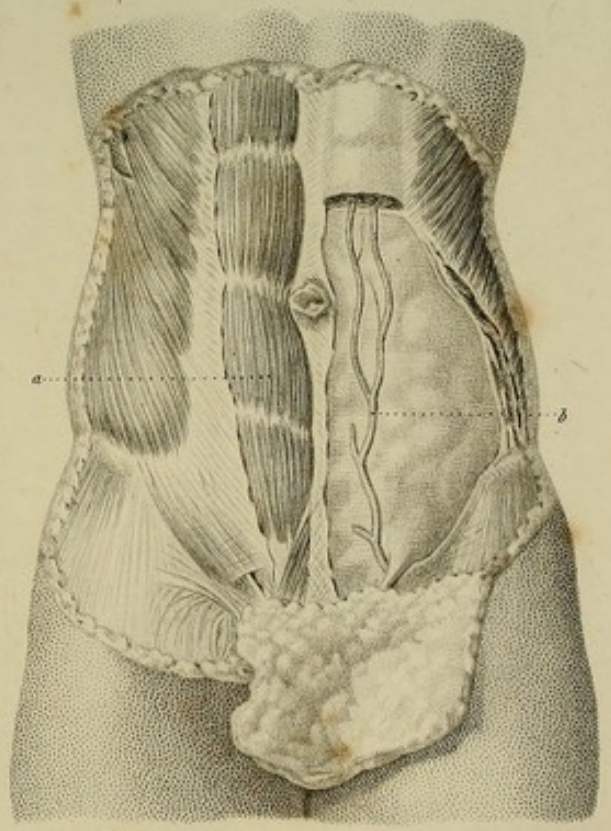


Fig. 2



apparatus consists of a trochar, a long, broad bandage, with which the abdomen is compressed as the fluid escapes, and small compresses used for dressing.

The patient lies down upon the edge of the bed, and the surgeon ascertains by percussion the level and extent of the effused fluid, so as to avoid wounding the intestines by plunging the trochar into some locality of the abdomen where they might be exposed. An assistant should press systematically with both hands upon the side opposite to that in which the operation is about to be performed.

The surgeon then firmly grasping the trochar, with the index finger extended along the stem (see plate 73, fig. 1), in order to limit the distance which the trochar shall enter the abdominal cavity, plunges the instrument at once into the abdomen. The canula is then held in position with one hand, while the trochar is being withdrawn by the other. The orifice of the canula may be obstructed, and the fluid prevented from escaping, by flakes floating in the serum, or by the contact of the omentum, or of the intestine, with the internal orifice of the canula; these obstacles can be removed by turning the canula in different directions, or by passing a stylet through it. The fluid should escape slowly, and while it continues to flow, an assistant should keep up regular compression by means of the long broad bandage. The object of this compression is to prevent too sudden dilatation of the mesenteric vessels, and to avoid producing syncope, which might otherwise result from too rapid a depletion of other parts of the circulatory system.

When a sufficient quantity of the fluid has been evacuated, the canula should be withdrawn, a small compress placed over the wound, and pressure kept up by means of the long, broad bandage.

Method of Fleury of the Val de Grace Hospital.—This consists in introducing a gum-elastic catheter into the canula, which is left in position while the canula itself is withdrawn.

The catheter follows up more perfectly the contracting abdominal walls, and may be plunged deeper into the peritoneal cavity than the canula, an advantage which allows it to remain permanently for a considerable space of time.

If hemorrhage should supervene, a very rare accident, the canula should be allowed to remain, or a piece of a wax or gum-elastic bougie inserted in its place; we may also compress a fold of the skin in which the edges of the wound are included.

Baudens' method.—It sometimes happens that the abdominal effusion makes its escape spontaneously, having distended and ulcerated the skin at the umbilicus. The fistulous opening thus formed allows the fluid to escape continually, as fast as it is secreted. To imitate this process of nature, Baudens invented a canula, which remaining permanently in the wound, and closing of itself, allows the patient to evacuate the serum as fast, or as soon, as it collects. The umbilicus is the place preferred by Baudens for the insertion of his canula. This method, which requires a special instrument, is only an excellent modification of the mode recommended by Fleury.

We shall not dwell upon the different means, such as injection, the introduction of foreign bodies, etc., which have been proposed for the radical cure of ascites.

These various methods are dangerous, and it is much better to perform the operation of paracentesis as often as the disease requires it.*

GASTROTOMY.

This operation can only be required for the removal of a foreign body in the stomach, and is alone justifiable when it can be readily felt externally, and gives rise to dangerous symptoms, its passage through the pylorus being ascertained to be impossible. The incision must be made upon the tumour caused by the presence of the foreign body, or upon the abcess already formed. If external signs of the presence of the foreign body are wanting, an incision from two and a half to three inches in length may be made in the epigastrium, along the median line. The peritoneum is to be cautiously divided, the trans-

* In this country the linea alba is preferred as the site of the puncture in the operation of paracentesis abdominis. The bladder is always evacuated before the operation, and the opening made as low down in the linea alba as the position of the bladder will allow. The patient can generally be placed in the upright sitting position, and thus the most depending point is secured for the puncture. There is obviously less danger of wounding the epigastric artery in the central line, than on either side of it. Less pain is experienced in the operation if a lancet be employed for puncturing the integuments before introducing the trochar. In a patient too much debilitated to sit up, the French method may be employed, or even the umbilicus selected with perfect propriety as the seat of the puncture. Oozing of serum sometimes continues after the dressing, but does not materially add to the danger. In case of bleeding, the lips of the wound may be transfixed by a needle, and closed by a figure of 8 suture.—Ed.

verse arch of the colon depressed, and the stomach, being fairly exposed, is to be opened so as to avoid wounding the coronary arteries.

It is unnecessary to dwell upon the dangers which may arise from the performance of an operation so severe as this of gastrotomy, and it would be advisable for surgeons, before resorting to it, to make trial of some of the various lithontriptic instruments which can readily be introduced into the stomach through the æsophagus.*

ABSCESS OF THE LIVER, TUMOURS OF THE GALL BLADDER, HYDATID CYSTS.

In these several forms of disease the abdominal parietes have been usually traversed by incisions made at different periods.

When abscess of the liver has given rise to a tumour which can be felt externally, and when fluctuation is evident, the visceral and parietal layers of the peritoneum have already formed adhesions with each other to such an extent that the abdomen can be opened without any danger of an effusion into the peritoneal cavity. When the diagnosis is clearly made out, an incision cautiously made, and so short as not to extend beyond the limits of the adhesions, will give immediate and safe exit to the pus. But the surgeon must proceed with great caution, when the diagnosis is doubtful, and the existence of adhesions is not perfectly made out.

Method of Graves.—The tissues are divided layer by layer until the peritoneum is reached, when the wound is dressed in with lint, and the inflammation which follows produces adhesions, and thus the abscess is safely discharged.

Begin's method.—The tissues are divided down to the peritoneum and the wound dressed in the same way as in Graves' method; by the third day adhesions are formed, and the abscess is opened with the bistoury.

Recamier's method.—By this method the peritoneum is reached by successive applications of caustic potash. The eschars create adhesions, and the swelling is opened with a bistoury or trochar. As the

* The term gastrotomy has been more widely applied, in its English meaning, to those rare operations, involving the abdominal walls, which have been occasionally undertaken for the relief of invagination, and internal strangulations of the intestine.—Ed.

walls of an abscess in a parenchymatous organ like the liver do not collapse, a cavity into which air may enter necessarily remains. It has therefore been proposed to inject into this cavity a quantity of water containing mucilage to take the place of the pus which has been evacuated.

It has also been proposed to open *tumours of the gall bladder* in the same way as abscesses of the liver; but the difficulty of an exact diagnosis in these cases, should always suggest the greatest caution in regard to them. Since the fluids contained in *hydatid cysts* are not of an irritating nature, they may be punctured; but it is always safer to proceed as in the case of suspected abscess.

OVARIAN CYSTS.

Ovarian cysts are infinitely variable in volume, form, nature and consistence. One variety consists of a mass of fatty matter, which sometimes contains teeth, hair, fragments of bones, etc., and is usually attributed to incomplete fecundation. Dropsical cysts contain fluids of every color, which are more or less consistent. Sometimes they present themselves in the form of a single large sac, filling up the whole abdominal cavity; at other times, of an aggregation of cells, which do not communicate with each other, and contain fluid. The relations of these varieties of tumours with other organs are also very variable. Sometimes they contract adhesions with the omentum, peritoneum, etc., and in other cases the tumour is isolated and pedunculated.

Modes of operating.—Puncture.—Puncture, which is only adopted in the treatment of dropsical cysts, is simply a palliative. It may be performed either at the most projecting point of the tumour, or through the vagina. Puncture through the abdomen is preferable, as there is less danger of its being followed by peritonitis.

To obtain a radical cure, the employment of compression and irritating injections, in connection with puncture, has been proposed. But these mixed methods have not as yet been warranted by experience, and to prevent accidents which might result to the patient from their employment, it is better for the surgeon to limit himself to simple puncture.

Incision, which was advised by Ledran, is well suited to the treatment of multilocular cysts, and to those which contain fluids of a con-

siderable degree of consistence. A longitudinal incision is made, either in the median line, or at the outer border of the rectus muscle, and upon the most projecting portion of the tumour; the tumour itself is then opened by an incision in the same direction, and as many of the cells broken down as can be reached; a plug of lint is then inserted into the wound, and the suppuration which soon takes place does the rest.*

Extirpation, or Ovariotomy, first successfully performed by Laumonier in the Eighteenth Century, was revived in modern times by McDowell, of Kentucky.

McDowell's method.—Divide the skin and the linea alba by an incision in the median line, extending from the umbilicus to within three-fourths of an inch of the pubes. Seize the peritoneum with a pair of forceps and make a very small opening in it, either with the scissors or bistoury. Through this opening introduce a director beneath the membrane, so as to isolate the peritoneum from the subjacent parts, and facilitate its division to an extent proportionate to that of the incision already made in the integuments.

The tumour can then be examined by the hand, and the presence of adhesions, if any, recognised. When these adhesions are slight, and offer but little resistance, divide or tear them, by which means the base of the tumour can more readily be made out; but if they are numerous and strong, the surgeon must renounce all attempts at extirpation, and limit himself to opening the cyst.

If the pedicle, when fairly exposed, be found to be narrow, it may be surrounded by a strong ligature; but if it be large, a needle threaded with a double cord should be passed through it, and in this way as many ligatures as may be necessary can be readily applied; the pedicle should be divided half an inch or an inch from the ligatures.

The operation being concluded, bring the external wound together with points of interrupted suture, taking care, however, not to include the peritoneum.

The length of the incision should depend upon the size of the tumour; in some cases it may be necessary to carry it from the xiphoid cartilage to the pubes.

* Modern experience will hardly confirm the utility of this operation.—Ed.

WOUNDS OF THE ABDOMEN.

SIMPLE PENETRATING WOUNDS.

When wounds of the abdomen exceed an inch in length, there is generally a protrusion, either of the intestines, or omentum. If these protruded organs are not wounded, they should be washed with tepid water, and immediately returned. It may sometimes be necessary to enlarge the opening in order to effect the reduction, which being completed, the edges of the wound in the abdomen are brought together with points of interrupted, or twisted suture. The peritoneum must not be included in the stitches. Strips of adhesive plaster should then be placed between the stitches, and a long bandage applied around the abdomen.

WOUNDS OF ABDOMEN WITH STRANGULATION OF THE PARTS PROTRUDED.

Hernial protrusions may be strangulated by the wound itself, and these strangulations give rise to symptoms severe enough to require the interference of art. The nature of the protrusions and the intensity of the symptoms will suggest the proper treatment to the surgeon.

Strangulation of the omentum.—Simple strangulation.—The protruded omentum is to be carefully unfolded and examined to ascertain that none of the intestines is included within it. If the omentum is alone protruded, and the patient on leaning backward experiences no dragging sensations, it is better to leave the omentum unreduced. Adhesions form between the omentum and the edges of the wound, the portion of the omentum external to the wound becomes gangrenous, and falls off, and the wound heals of itself. But if the protruded portion be large enough to give rise to unpleasant symptoms, or to prevent the patient from leaning backward, or straightening himself, it must be reduced, the external wound being

dilated, if necessary. As the omentum always protrudes from above downwards, the rule is to enlarge the wound in the direction of its inferior angle.

When the protruded omentum is gangrenous, it is better to wait for it to fall off of itself, than to attempt to reduce it by making a section of the living parts, lest an internal hemorrhage should take place.

Strangulation of the intestines.—The first indication is to diminish the volume of the protruded intestine; gentle and methodical pressure will frequently effect the reduction; cold applications may possibly be useful to produce contraction of the intestine. Ambrose Paré proposed to prick the intestines with a pin, to give exit to the gas.* When these means fail, the surgeon is compelled to enlarge the wound, to enable him to effect the reduction.

The patient is placed upon his back, with his thighs flexed so as to relax the abdominal parietes, and the surgeon, with his left hand, depresses the protruded intestine, while, with his right hand, he introduces the extremity of a director into the superior angle of the wound. The director is then slid beneath the peritoneum, and serves as a guide to the blade of the bistoury, with which the enlargement of the wound is effected. Care must be taken that the protruded intestine does not project over the groove of the director, and that the intestine within the abdomen be not wounded with the bistoury.

When the director cannot be introduced, the integuments must be divided, layer by layer, until the peritoneum is reached. The operator then depresses the intestines with his left hand, and, keeping one of his fingers in the superior angle of the wound, proceeds by careful and successive incisions to divide the various layers, until he reaches the peritoneum, which he incises upon the director.

Various instruments have been invented, with a view of facilitating the enlargement of the wound: such as Méry's director, with a plate on each side (see plate XVI., fig. 1), and Pott's bistoury (same plate, fig. 6), &c. The ordinary probe-pointed bistoury, with a portion of its blade wrapped round with adhesive plaster, answers, all purposes for performing the operation.

* Neither the application of cold to a protruded intestine, nor pricking it with a pin, is considered good practice at the present day.—Ed.

(*Plate* 59.)

If the wounded intestine remains in the abdomen, the only treatment required should be directed to the prevention of an attack of peritonitis by the employment of antiphlogistic measures. When the wound in the abdomen is large enough to allow the folds of the intestines readily to be brought out, the surgeon should attempt to find the injured intestine, and, if the wound in it be half an inch, or upwards, in length, to bring it together by means of sutures.

We shall describe farther on certain operations which have been proposed for the establishment of an artificial anus, and limit ourselves, for the present, to the description of such means as may be employed to obtain an immediate cure, by bringing the edges of the wound together, without stoppage of the intestinal canal. The modes to be adopted vary according as the wounds are longitudinal or transverse.

§ 1. *Longitudinal wounds.*—(The loop suture.)—*Palfyn's method.*—This method consists in bringing the lips of the wound in the intestine in apposition with the peritoneal surface of the wound in the abdomen. To effect this, a loop of thread is carried through the edges of the wound, which holds them together, and the ends of the thread being fastened externally, bring the intestine closely in contact with the abdominal wound. This method, which is very easy of execution, has the objection that it may ultimately tend to the formation of an artificial anus.

Ledran's method.—This method, which is more complicated than the preceding, depends upon the same principle. Several loops of thread, with the distance of a line and a half intervening between them, are carried through the intestine, in the same way as Palfyn's method. The ends of the threads are then brought together, and twisted so as to approximate the edges of the wound, and produce a wrinkling of the fold of intestine, and the ultimate union of the wound: the twisted ends of the sutures are united and firmly fastened outside the wound.

Reybard's method (see plate 59, fig. 2).—The object of this method is to effect an adhesion between the peritoneal membrane which covers the intestines, and that which lines the walls of the abdomen. Rey-

bard uses a small strip of wood, with its edges rounded, in the middle of which two holes are made about a line apart; a loop of thread is carried through these holes, and the piece of wood is introduced by the wound into the intestine, in the same way as a button is passed through a button-hole. This proceeding leaves the two extremities of the thread external to the wound. A needle is then threaded with each end. The surgeon now seizes a lip of the wound, and carries one of the needles through it from within outwards, and then repeats the same manœuvre with the other needle. The strip of wood and both edges of the wound in the intestine are thus contained within the loop. Curved needles are then threaded with the ligatures, which are carried from within outwards through the edges of the wound in the abdomen, in the same way as the other needles had been carried through the edges of the wound in the intestine. The intestine is then returned; and, by tying the threads together externally, the strip of wood forces the outer face of the intestine against the peritoneum, and thus union is effected.

Reybard cuts the thread two days after the operation: the strip of wood, being no longer held in its position, falls into the intestine, whence it is expelled.

Figure 2 represents a transverse section of the intestine brought in contact with the peritoneum, by means of Reybard's strip of wood. *b*, *b*, *b*, the intestine; *c*, the strip of wood; *d*, the loop of thread; *d*, *d*, knot tied externally in the thread which has been carried through the abdominal parietes, *a*, *a*.

Method of Astley Cooper.—When the wound in the intestine is very small, it may be seized entire between the jaws of a pair of forceps, and a ligature applied around it, as if it were an artery.

Jobert's method.—Several loops of thread are carried through the edges of the wound, and then reversed in such a way that the serous surfaces will be brought in contact, when the threads are tied.

Moreau Boutards method.—The mucous membrane which rolls over the edges of the wood is incised, and points of interrupted suture are inserted so as to bring the fleshy cut surfaces in contact; one end of the suture is cut off close to the knot, and then carried through the abdominal parietes, so as to effect, at the same time, union of the edges of the wound, and their adhesion to the walls of the abdomen.

Pelletier's suture, described on page 7, is applicable to wounds of

the intestine. When the edges of the wound in the intestine are once brought together, the threads are also useful in bringing the intestine into the external wound. At the end of five or six days, the sutures may be carefully withdrawn.

Reybard's method.—This is a slight modification of the ordinary continued suture. An ordinary sewing needle is employed, armed with a double thread, to the free ends of which a little plug of linen is fastened. The needle is first passed through one lip of the intestinal wound, near one of its angles, and from within outwards; the plug of linen brought against the mucous membrane fastens the extremity of the thread, and also serves ultimately to drag the ligature into the cavity of the intestine, so as to secure its evacuation by stool. When the whole wound is closed, the double thread is separated and cut, and the last stitch made with a single thread; the cut ends are then tied, and cut off close to the knot. The bowel is then reduced within the abdomen; the ligature cuts itself out, falls into the intestine, and is voided by stool.

Gely's method.—Laced suture (Plate 59, fig. 1).—This method will be better understood by referring to the description of the plate. A waxed thread is used, armed at each extremity with an ordinary needle. One of these needles is introduced into the intestine, on a line parallel with the wound, and about two lines behind and without one of its angles; the same manœuvre is repeated on the opposite side with the other needle. The threads are then crossed; the left needle is passed to the right, and the right needle to the left. Each is then introduced from the serous to the mucous surface of the bowel through one lip, carried across the wound within the bowel, and brought out at a corresponding point in the opposite lip, passing, of course, from within outwards; thus, each needle passes through the same hole, and each hole carries two threads. This manœuvre is repeated until the whole wound is closed, and before tying the two ends of the thread, each stitch should be separately tightened by using two pairs of dissecting forceps, and drawing each as snugly as possible, very much after the fashion of a corset lace. It results from this arrangement that the serous surfaces of the two lips of the wound are brought accurately and neatly in contact, and the thread is buried so completely as to be hardly visible. After tying the two ends of the thread, they are cut off close to the knot. The points at which

each lip of the wound is perforated by the needles, should be just two lines from its free margin, so that a distance of four lines intervenes between the opposite points.

Gely uses sewing silk of the ordinary size, and recommends that the surgeon, when he has finished two points of suture on each side, should tighten them, and then secure them by means of a small knot.

§ 2. *Transverse wounds.—Invagination; contact of the serous and mucous surfaces.—Ramdohr's method.*—The upper end of the intestine is inserted into the lower, and the two surfaces kept in contact by points of suture.

Direct union of the edges of the wound.—Duvcrger's method.—Duverger used a piece of calf's trachea, furnished with loops of thread placed at equal distances, each extremity of which was threaded with a curved needle. The trachea was then introduced into the two extremities of the intestine, and the needles being carried through the gut from within outwards, fastened upon it the edges of the intestine, margin to margin; the threads being tied kept the edges in contact.

Jobert's method.—When the omentum presents itself in front of the wounded intestine, Jobert interposes a fold of it between the lips of the wound in the intestine, and brings the edges together by sutures, after Ledran's method. Thus, serous surfaces are everywhere in contact.

Union of the serous surfaces.—Serous membranes readily unite by adhesion when they are kept in contact. Mucous membranes, on the contrary, require a much longer time to unite, and adhesion between serous and mucous surfaces brought in contact with each other, cannot be readily effected. These facts, which were first pointed out by Bichat and Richerand, served as a basis for the researches of surgeons, and of the several methods which we are about to describe.

Jobert's method (fig. 3).—The two ends of the intestine being recognized, are isolated from the mesentery for about the third of an inch, in order to facilitate the insertion of the superior into the inferior extremity. If the hemorrhage following the incision of the mesentery be slight, no attention need be paid to it; but if it be considerable, a temporary ligature, or torsion, will usually put an end to it.

The operator then seizes the upper end of the intestine with the left hand, and with the right carries a needle threaded with a ligature of the proper length from within outwards, through the intestinal wall,

and about three lines above its cut edge. A loop of thread is thus passed through the upper end of the intestine, and its extremities given in charge to an assistant. A second thread is then passed in the same way through the bowel, at a point diametrically opposite to the first.

The surgeon then inverts the edges of the lower end of the bowel, and inserts the index finger of the left hand into it, in order to preserve this inversion, the object of which is to bring the serous surfaces of the gut inwards. Each of the threads held by the assistant are then threaded with a curved needle, which the surgeon slides along the finger introduced into the intestine, and carries it through the doubled border of the lower end of the gut. The second end of the first thread is then passed through in the same way about two lines from the first, fig. 3 *a*. The same thing is repeated with the free extremities of the second thread *b*; when a gentle and methodical traction upon the threads will be found to effect invagination. The loop of thread draws the upper end of the intestine into the lower, and invagination being thus produced, the whole can be held in position by tying the ends of the threads, or by additional points of suture. The intestine is then returned into the abdomen, and the threads, brought together in the lower angle of the wound, are attached externally with a piece of adhesive plaster.

Lembert's method (figs. 4 and 4 bis; see explanation of plate 59).—In this method the serous surfaces are brought in contact by folding in and wrinkling or puckering together the edges of the wound. As many threads are employed as there are points of suture to be inserted. A sewing-needle is threaded with each. The needle is passed through the gut from without inwards about a third of an inch above the wound, and brought out again also about two lines above the wound, across which it is carried and again inserted three lines below the wound, and brought out at the distance of two lines from the last place of insertion (figs. 4 and 4 bis show the course of the thread). By drawing upon the ligatures, the edges of the wound are inverted, and their serous surfaces brought in contact, which being effected, the threads are tied, their ends cut off close to the knot, and the intestine returned.

Denan's method, Fig. 6.—By this method, adhesion of the serous surfaces is effected by the introduction of a foreign body within the bowel. Three silver or copper ferrules, or rings, are used. The cen-

tral ferrule is about two-thirds of an inch in width, and the same in diameter; the two others are each one-third of an inch in width, and in diameter a little larger than the central ring, so that the intestine can be inserted and retained between them and the central ferrule.

Both ends of the intestine are detached from the mesentery, for about the third of an inch. The two narrower ferrules of the greatest diameter, *b*, *b*, are introduced, each into an extremity of the intestine, whose free edge is then inverted into the ferrule *bb*; when one of the ferrules is thus encircled by the edges of the intestine, the central ferrule *a*, is introduced, which keeps the intestine in its position, and, by its pressure prevents it from becoming disengaged. The ferrule *a*, hitherto inserted into one external ferrule only, is then slid down into the other ferrule *b*, by which means the serous surfaces of both ends of the invested intestine are brought in contact, and retained in position.

A loop of thread is inserted into the intestine to keep the three metallic rings firmly in position. A needle is threaded with silk, inserted above all the rings, carried through the central ferrule *a*, and brought out at *f*, below. It is then re-inserted at *f*, carried along between the intestine and the external rings *f'*, and brought out at *g*. Figure 6 represents the direction taken by the thread *dd*, *d'd' ff'*, and *g*. The ends are now tied, and cut off close to the knots, and the intestine then returned. The serous surfaces adhere to each other between the external rings, and the two edges which are invested slough off. The ferrules which are thus disengaged in the interior of the intestine are expelled with the stools. The central ferrule may be made of a very wide watch spring (see Instruments, plate XV., fig. 1 and 2), the introduction of which into the silver ferrules may be facilitated by grasping it with a pair of forceps.

Amussat's method, Fig. 5.—A cork *aa*, swelled at each end and having a circular groove around its middle, is inserted into the intestine. The upper end of the gut, with the cork, is then inserted into the lower portion, and kept firmly in this position by the thread *bb*, which encircles the overlapping edges of the wound. The cord produces inflammation, which ultimately effects adhesion of the serous surfaces. The ligature cuts through the tissues, which heal naturally, and the former, passing into the bowel, is expelled, together with the cork, in the stools.

Summing up.—All of the methods which we have described have not as yet been performed upon the living body. The essential conditions to the success of the operations must first be studied, in order to appreciate their relative value.

On the one hand, the readiness with which serous membranes unite, when brought in contact, and on the other, the difficulty which is experienced in effecting adhesion between two membranes of different natures, bring us at once to a point where a choice between them is readily made; and we have, then, only to determine upon the method to be employed which offers the best chances of success. The essential point is to bring the serous surfaces of the edges of the wound in contact. It is very necessary that these surfaces should be brought and kept in exact contact in every part, in order that union may be secured, and all effusion into the abdomen prevented. The diameter of the intestine must also be diminished as little as possible, and there must be no projections into it which can in any way obstruct the free passage of fecal matter. Finally, the finer the points of suture, the less will be the stricture, and consequently the chances of any accident resulting will be diminished.

Gely's method, applied to longitudinal wounds, meets better than any other the various conditions required for the exact closure of the wound; the only objection to it is, that it exposes the intestine to greater danger from the numerous punctures which are required. Simple loops, or Reybard's method (the continued suture), will expose the patient to less danger.

The same principles are applicable to wounds across the intestines. Gely's method may be advantageously employed in these cases. Jules Cloquet has performed Lembert's operation upon a patient. Denan's method, which is easy of execution, has also been performed upon a patient by Guersant. The autopsy showed a perfect cicatrization of the intestine, without retraction. The inconvenience which might result from the presence of metallic substances in the intestine, suggested to Bourgery the idea of using ferrules made of some substance solid enough to remain in place as long as would be required for peritoneal adhesions to take place, but which would finally be so altered in shape, and even converted into a paste, that it would be readily expelled from the intestines. Gelatine ferrules, strengthened by a coating of drying oil, may be found to answer this purpose.

Pl. 59

Fig. 1.

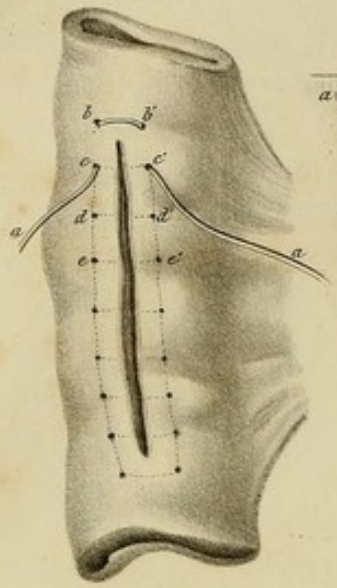


Fig. 2.

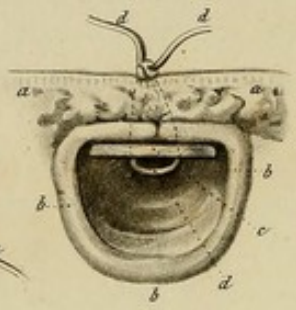


Fig. 3.

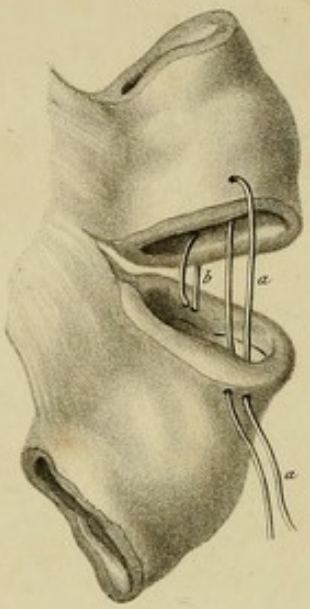


Fig. 4.

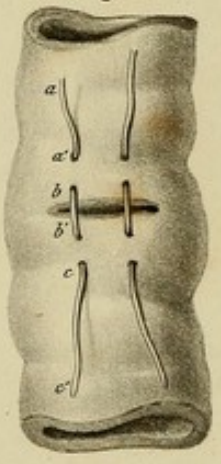


Fig. 5.

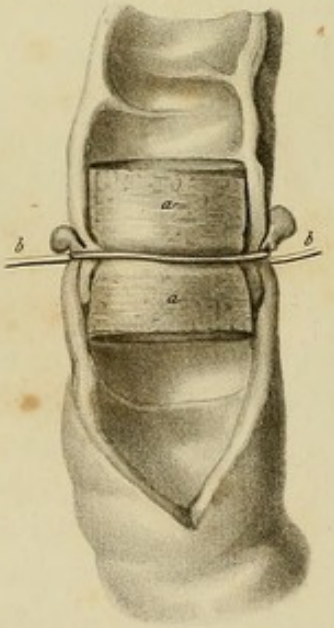


Fig. 4 bis

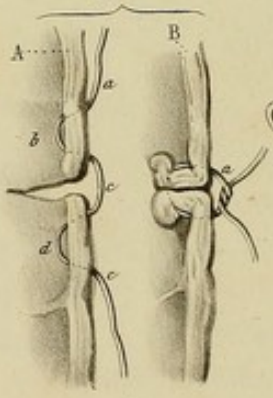


Fig. 6.

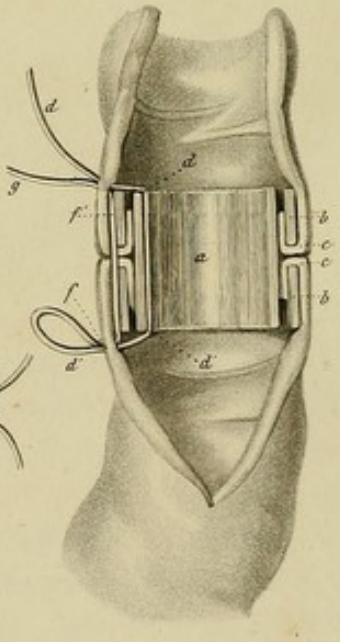


Plate LIX.

WOUNDS OF THE INTESTINES.

Fig. 1. *Gely's method.*—A well-waxed silk thread is used, each end of which is armed with a needle. One of the needles is inserted at *b*, above and about two lines beyond the upper angle of the wound and is brought out at *c;* the second needle is inserted at *b'*, and brought out some three lines below at *c'*. The plate represents this, the first stage of the operation. The ends *a*, *a*, are then crossed transversely in front of the wound, so that the thread which was brought out at *c'*, can be inserted at *c*, and vice versa; the needles are then brought out at *d*, and *d'*, the threads again crossed as before, and the needles re-inserted; the operation is continued in this way until the sutures have been carried a line or two below the lower angle of the wound, when they are tied. Externally, the wound is thus brought together by a double thread, which crossing it in the direction *b b'*, *c c'*, *d d'*, brings the serous surfaces in contact; internally, two threads carried along at *b c d e*, and *b' c' d' e'*, parallel to the wound, serve to maintain this union.

Fig. 2. *Reybard's method.*—The figure represents a transverse section of the intestine, and of the abdominal walls on a level with the wound. *a a*, abdominal wall; *b b b*, intestine; *c*, slip of wood introduced into the intestine; *d d d*, a loop of thread carried through and holding the slip of wood, the intestine and the abdominal wall close in contact.

Fig. 3. *Transverse wound of the intestine.—Jobert's method.—Bringing the two serous surfaces in contact.*—Two loops of thread, *a a*, and *b*, are carried through the upper end of the intestine. The lower end of the intestine is turned inwards, and with the needle the thread is carried through the edge of this doubled intestine and serves to keep it inverted. By pulling upon the threads *a*, and *b*, the upper end of the intestine is drawn into the lower, and the serous surfaces are thus brought in contact.

Fig. 4 and 4 bis. *Lembert's method.*—The surgeon must have as many threads armed with a needle as he proposes to insert points of

suture. A thread *a*, is inserted at *a'*, and brought out at *b ;* this thread is then carried over the transverse wound in the intestine and again below at *b'*, and brought out anew at *c*. The other threads are passed through in the same manner.

Figure 4 bis represents the course of the thread *a b c d e*, through the wall of the intestine A. Pulling upon the thread and tying it brings in contact the serous surfaces of the edges of the wound B.

Fig. 5. *Amussat's method.*—Longitudinal section of the intestine, showing the cork *a a*, upon which the two ends of the gut, mucous surface against serous surface, are firmly fixed by the thread *b b*.

Fig. 6. *Denan's method.*—Longitudinal section of the intestine and ferrules, showing the arrangement of the instrumental apparatus. *a*, the central ferrule; *b*, *b'*, two external ferrules narrower and larger than the central ferrule *a*. A thread *d d d' d' f f' g*, holds the apparatus in position.

The edges of the wound of the upper end of the intestine *c*, are folded around the upper ferrule *b*.

The lower edge of the wound *c'* is folded around the lower ferrule *b'*.

The central ferrule *a*, keeps these inverted borders in position, and presses them against the inner surfaces of the two ferrules *b b'*. The two serous surfaces of the intestine are thus brought in contact.

The thread *d d' f f' g*, keeps the various ferrules in their proper place.

Pl. 60.

Fig. 1.

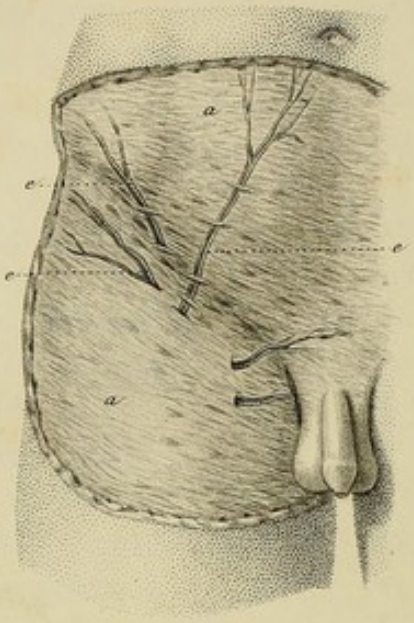


Fig. 2.

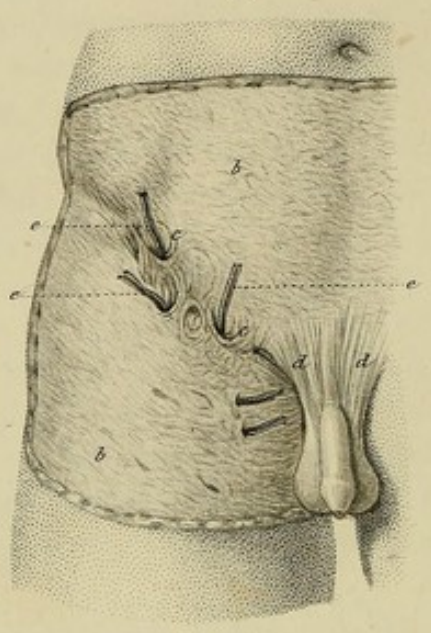


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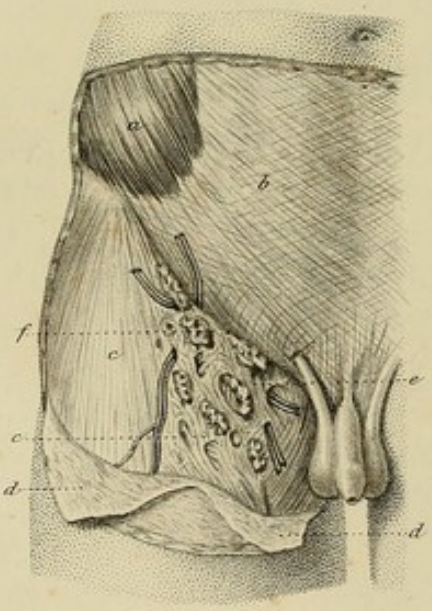


Fig. 4.

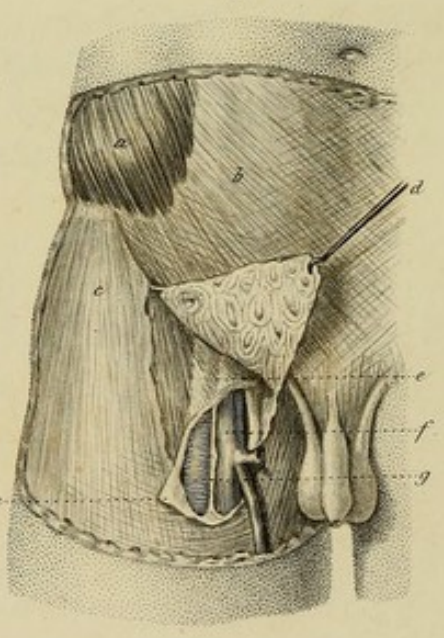


Plate LX.

HERNIA.

SURGICAL ANATOMY OF THE INGUINAL REGION.

Fig. 1. The skin and sub-cutaneous cellular tissue have been removed throughout the entire region; *a a*, the superficial layer of the sub-cutaneous fascia; *e e*, superficial vessels traversing the meshes of this fascia.

Fig. 2. Deep layer of the superficial fascia; its meshes *b b*, are coarser; *d d*, fibres of the dartos; *e e e*, superficial vessels converging towards the crural arch, and passing through openings by which the superficial fascia is pierced at numerous points.

Fig. 3. The superficial fascia has been entirely removed. In the abdominal region, beneath this layer, we find the obliquus externus muscle *a*, and its aponeurosis *b*; in the crural region, the fascia lata *e e*, whose superficial layer is completely riddled with foramina. Numerous lymphatic glands *e f*, are scattered over this layer, which covers the sheath of the femoral vessels. The sub-cutaneous fascia of the thigh *d d*, has been turned back; this fascia covers in the lymphatic glands, and becomes continuous with the sub-cutaneous abdominal fascia over the crural arch. The sieve-like, or cribriform cellular layer, which joins the fascia lata *c*, externally, may be considered as an extension of the abdominal fascia, which extension is covered by the crural fascia *d*; the lymphatic glands *e f*, lie between these two layers.

Fig. 4. The cribriform layer, detached from the fascia lata *c*, is held up by the hook *d*. The femoral vessels lie beneath this layer; the femoral vein *f*, and the femoral artery *g*, are seen enveloped in a cylindrical or funnel-shaped investment of membrane, known as the *femoral sheath*, *e e*.

The cavity of the femoral sheath is divided by a central partition into two compartments, of which the external lodges the artery, and the internal, the vein; on the inner side of the vein there is a vacant space—this is the femoral ring, through which femoral hernia escapes.

Plate LXI.

CONTINUATION OF THE SURGICAL ANATOMY OF THE INGUINAL REGION.

Fig. 1. A portion of the external oblique muscle and its aponeurosis *a*, is removed. Beneath it the internal oblique muscle *b*, is seen; the apeneurosis of the external oblique *c*, detached from its upper part *a*, is turned down upon the thigh. This portion of the aponeurosis is inserted into *Poupart's ligament*, or the *crural arch*, which we shall study hereafter in connection with figs. 5 and 6.

Fig. 2. The external and internal oblique muscles being removed, we bring into view the transversalis muscle *a;* the inguinal canal commences beneath the inferior fibres of this muscle. *b*, the circumflex iliac artery, emptying into the femoral artery, on a line with and beneath Poupart's ligament; *d*, the spermatic cord, lying in the inguinal canal; the aponeurosis of the external oblique which forms a part of the inguinal canal being removed, we see the relations of the cord with the inferior fibres of the transversalis muscle. The femoral artery and vein *c*, are seen coming out from beneath the transversalis muscle, from the iliac fossa, taking their course towards the thigh, and passing beneath Poupart's ligament (See fig. 5).

Fig. 3. All the abdominal muscles are removed; the aponeurosis *a*, of the external oblique, is turned back upon the thigh, as in plates 1 and 2. The fascia transversalis, *b*, is here brought into view, and its inferior portion being removed exposes the peritoneum *c*, which covers the intestines; the spermatic vessels and the vas deferens united to form the spermatic cord *d*, pass through the inguinal canal, and over Poupart's ligament; the fibres of the fascia transversalis continued down form one of the envelopes of the cord; *e*, course of the epigastric artery (see plate 17, fig. 1).

Fig. 4. This represents the posterior or peritoneal aspect of the abdominal wall, whose anterior structure we have already described layer by layer, from before backward (fig. 1, 2 and 3).

Pl. 61.

Fig. 1.

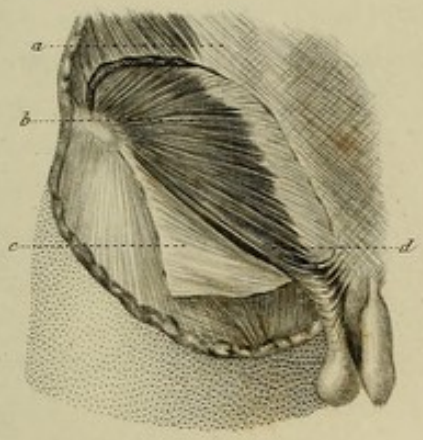


Fig. 2.

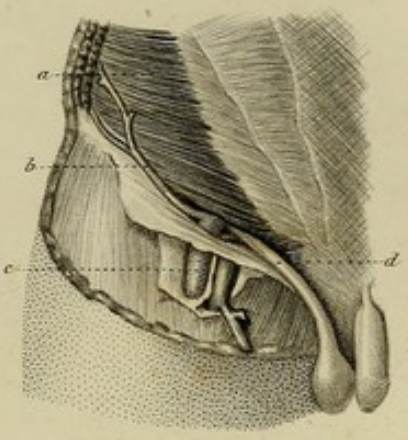


Fig. 4.

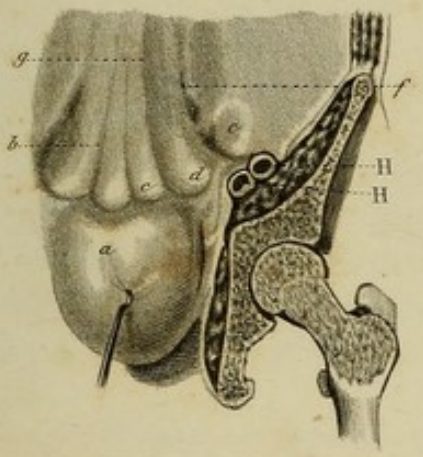


Fig. 3.

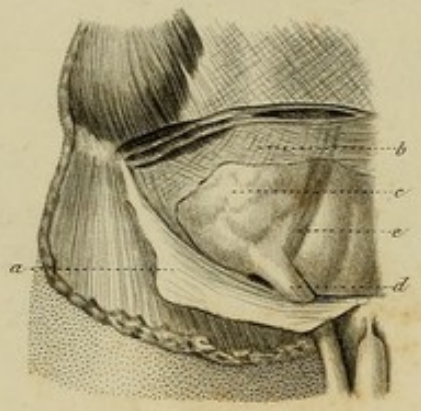


Fig. 5.

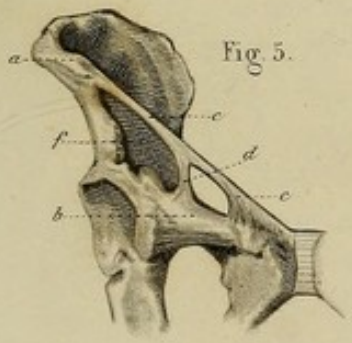
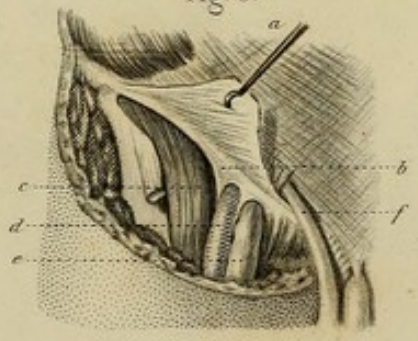


Fig. 6.



This peritoneal view shows the various projections and depressions produced by the organs lying beneath the peritoneum.

a, the bladder drawn downward by a hook. H H, the vessels divided. The *external inguinal fossa*, *c*, corresponds to the internal abdominal ring, or the abdominal orifice of the inguinal canal, traversed by the spermatic cord. Internally this fossa is limited by the projecting ridge of peritoneum formed by the epigastric artery, which passes upwards between the peritoneum and the abdominal vessels. This artery (see plate 17) curves inwards beneath the cord, and consequently lies internal to hernias escaping through the external fossa. (*External, or oblique inguinal hernia*, see plate 64, fig. 1.)

The *internal inguinal fossa*, *d*, is situated between the line of the epigastric artery *f*, and the prominence formed by the obliterated umbilical artery *g*; this fossa corresponds to the external abdominal ring, and to the inguinal canal, and gives passage to direct, or *internal inguinal hernias* (see plate 64, fig. 2), which, escaping to the inner side of the epigastric artery, have this vessel, of necessity, to their outer side.

A third fossa, the *vesico-inguinal*, lies between the projection of the umbilical artery and that of the external border of the rectus muscle, and corresponds also to the external abdominal ring. Hernias in this fossa are called *direct* hernias. H H, divided femoral vessels.

Fig. 5. *Poupart's ligament, or the crural arch; Gimbernat's ligament.*

a, anterior superior spinous process of the ilium; *b*, horizontal ramus, or body of the pubes; *c c*, Poupart's ligament, or the crural arch; *f*, anterior inferior spinous process of the ilium.

Poupart's ligament, or the crural arch, consists of a strong aponeurotic band, extending from the spinous process of the ilium *a*, to the spine of the pubes. *Gimbernat's ligament*, *c*, is formed by the most inferior fibres of the crural arch, which are reflected backwards and outwards from the spine of the pubes, and inserted into the pectineal line of the pubes *b*. This ligament, an aponeurotic expansion of the crural arch, by its reflection backwards and outwards, forms a species of septum, which separates the fossæ of the crural canal, which we have described above. There is another ligament, *d*, which rises from the crural arch and is inserted into the pectineal line; this ligament forms the external boundary of an orifice which is bounded above by Poupart's ligament, within by Gimbernat's ligament *c*, and below by

the ramus of the pubes *b*. Through this opening the vessels, nerves, and femoral hernia pass. It should be remembered that femoral hernia always lies in the sheath of the vessels, and in contact with the femoral vein, which fact will readily indicate its relations with Gimbernat's ligament; these relations we shall again refer to.

Fig. 6. A hook, *a*, is holding up the fascia lata; *b*, Poupart's ligament, or the crural arch. The anterior portion of the sheath of the vessels is raised up, which exposes to view the femoral artery *d*, on the outer side; and within, the femoral vein *e*; *f*, the spermatic cord, escaping from the external ring of the inguinal canal. The explanation of plates 60 and 61, will assist materially in understanding the description which we are about to give of the inguinal and femoral or crural canals.

Inguinal canal.—This is a species of excavation in the substance of the abdominal walls, through which, in the male, the spermatic cord passes; in the female, the round ligament. Its course is oblique from above downwards, from within outwards, and from behind forwards. It has two openings: one internal and superior, called the *internal abdominal ring;* the other, external and inferior, called the *external ring.* The internal ring consists of an opening in the fascia transversalis through which the cord passes. We have already remarked that this fascia is prolonged upon the cord, and forms for it a species of enveloping membrane, known as the infundibuliform prolongation of the fascia transversalis. (See plate 64, fig. 2, and plate 61, fig. 3.)

The fascia transversalis, after allowing the passage of the cord through it at the internal ring, is prolonged downwards upon the cord, and is ultimately lost in the scrotum. This membrane is also intimately adherent to Poupart's ligament, as it passes down beneath it, and the two together form a grooved surface, or gutter, upon which the spermatic cord reposes, and which therefore is described as the floor, or inferior walls of the inguinal canal. The superior wall of the canal is made up of the inferior fibres of the internal oblique and transversalis muscles. The separation of the fibres of the tendon of the external oblique forms the external ring. The spermatic cord passes out between the *pillars* formed by the separation of these tendinous fibres.

The external pillar is inserted into the spine, and the internal, into the symphysis pubis; the separation of these fibres is prevented by

the prolongation of the fibres of the external oblique of the opposite side, which cross them above and below. The result of this arrangement is, that when the abdominal muscles are contracted, the external ring is closed, or nearly so, by the tension of these tendinous pillars.

The length of the inguinal canal varies from one to two inches. Its direction is parallel to that of Poupart's ligament, which forms its inferior wall. Its external orifice, or the external ring, lies about two-thirds of an inch, or an inch, to the outer side of the symphysis pubis.

In *young children*, the two rings are very near together, almost opposite each other; besides, the peritoneum in them frequently communicates with the tunica vaginalis testis. Hernia may therefore descend into the inguinal canal, or even into the scrotum, without any additional peritoneal sac. In consequence of this anatomical arrangement of the peritoneum, congenital hernia always lies to the outer side of the epigastric artery.

In the *female*, the inguinal canal contains only the round ligament of the uterus, and some blood-vessels; its internal or abdominal orifice is a simple fissure, which circumstance explains the rarity of inguinal, and also the frequency of femoral hernia in the female.

Plate LXII.

SURGICAL ANATOMY OF THE SCROTUM AND SPERMATIC CORD.

Fig. 1. *a*, penis drawn over upon the left thigh; *b b b*, skin of the scrotum; *c c c c'*, superficial fascia lying immediately beneath the skin; *d*, the dartos; *e*, intercolumnar fascia; *f*, cremaster muscle; *h*, infundibuliform prolongation of fascia transversalis; *g*, spermatic cord divided near its place of exit at the external ring.

Fig. 2. *Anatomy of the spermatic cord.*—*a*, tendinous fibres of the external oblique muscle; *b b*, intercolumnar fascia, continuous with the borders of the external ring; *c c*, the cremaster muscle; *d d*, infundibuliform prolongation of fascia transversalis; *e*, a director, carried beneath the spermatic vessels; *f*, vas deferens.

Fig. 3. *a*, the testicle; *b b b b*, the tunica vaginalis laid open; *c c*, tunic proper of the cord, continuous with the prolongation of the fascia transversalis. A dissection of the scrotum from without inwards presents the various envelopes of the testicle in the order in which we are about to describe them:

The *skin of the scrotum* (fig. 1, *b b b*), is thin, elastic, and is relaxed by heat and contracted by cold. It is lined by a layer of cellular tissue, forming a superficial fascia *c c*, which is continuous with the superficial abdominal fascia. The skin and fascia which line it form a species of pocket, or bag, for the testicles. This pocket, or bag, is furrowed externally by a well-marked *raphé* which is traceable along the median line.

The *dartos*, *d*, also forms two distinct pockets, consisting of very contractile reddish colored fibres. These fibres appear to take their rise from the fibrous tunic around the borders of the ring.

The *intercolumnar fascia*, *e*, is an expansion of the enveloping tendon of the external oblique muscle. It leaves the tendinous fibres of this muscle at the external inguinal ring, and goes down to form a very thin envelope for the cord and the testicle.

The *cremaster* muscle (fig. 2, *c c*) lies beneath this fibrous tunic. It is very thin and, according to Cloquet is formed from the inferior

Fig. 1.

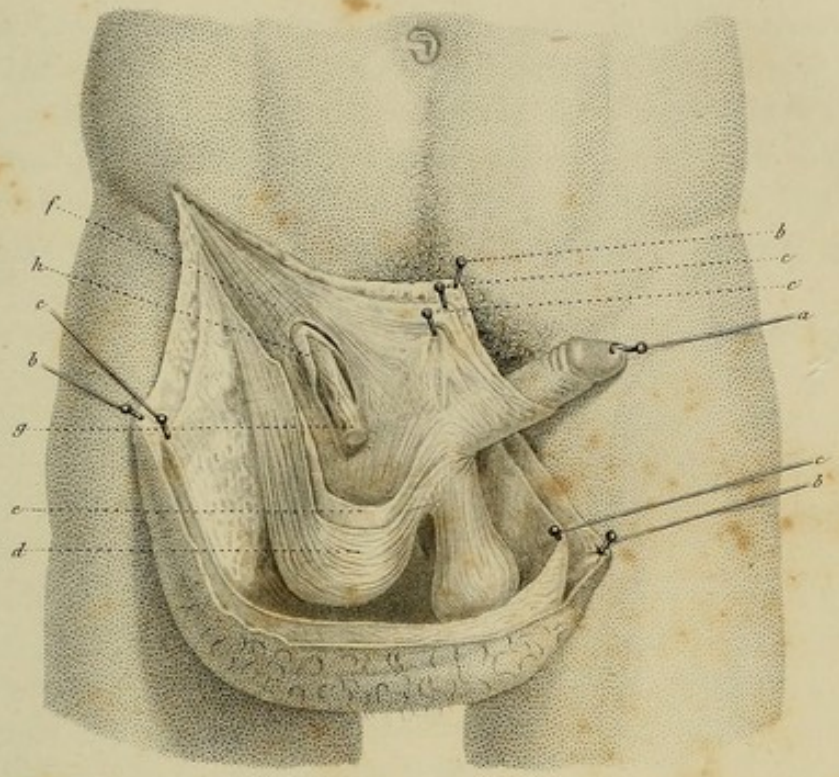


Fig. 2

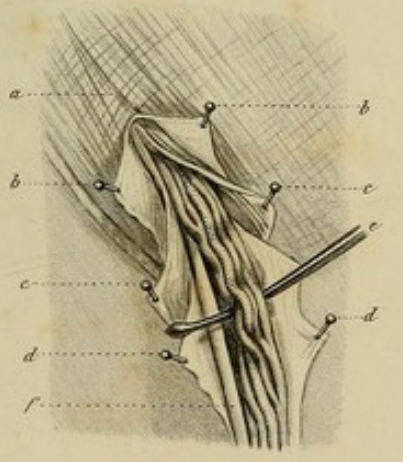
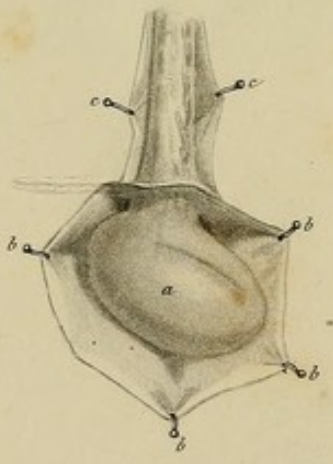


Fig. 3



fibres of the internal oblique muscle, drawn down by the descent of the testicle. It forms an envelope to the spermatic cord, consisting of muscular loops with their concavities looking upward, arising by a small fasciculus of muscular fibres around the circumference of the ring, and is continuous with another small bundle of fibres, which is inserted into the pubes. The fibrous tunic proper, or infundibuliform prolongation (fig. 1, *h*, and fig. 2, *d*), comes next. It appears to be a mere extension of the fascia transversalis.

The *vas deferens* and the *spermatic vessels* lie in the centre of these envelopes. The vessels are found in front of the vas deferens. The walls of the vas deferens are strong, thick and resistant. When operations are performed for the purpose of applying a ligature to the spermatic vessels, the vas deferens should be sought for, and carefully isolated.

The *tunica vaginalis* (fig. 3, *b b*), envelopes the whole of each testicle, except above and behind. This species of pocket sometimes communicates with the peritoneum, of which it is an appendage. It is frequently the seat of considerable serous effusions (hydrocele), and when there is a communication existing between it and the peritoneum, pressure upon the tumour will cause the liquid to flow back into the abdomen. The surgeon should assure himself that no such communication exists, before throwing irritating injections into the tunica vaginalis, for the purpose of effecting the radical cure of hydrocele.

Plate LXIII.

THEORETICAL EXPLANATION OF THE FORMATION OF HERNIAS.

The figures represent a section involving one of the abdominal openings, and the intestines in the different stages through which they pass in the formation of a hernial protrusion.

Fig. 1. *a*, abdominal opening; *b b b*, a mass of intestines forcing the peritoneum *c c c*, before it, and having a tendency to enter the opening *a ;* this is the first stage of the formation of the *sac.*

Fig. 2. The intestine *b b b*, and the peritoneum *c*, have passed through the opening *a a.* The process is in a more advanced state than in figure 1; but the sac *c*, is not as yet contracted at the opening; its *neck* is not formed.

Fig. 3. *b b b, a loop of protruded intestine* inclosed in the *peritoneal sac, c.* The sac is dilated into the shape of a bottle, *c*, and constricted on a level with the opening *a a.* This constricted portion of the sac is called its *neck.*

Fig. 4. *Formation of the sack by the peritoneum.*—The walls of the sac *d*, forming the neck, are considerably thickened in the neighbourhood of the opening *a a. c c c*, the body of the sac.

Fig. 5. Sometimes the sacs are multiplied and lie one upon the other, *e*, and *d.* When the sac is forced downward and its neck fairly formed, a second sac with an equally well-marked neck may also be formed in addition to the first; *c*, the peritoneum of the hernial sac, which is much thickened, especially at the constricted points.

Fig. 6. When the first neck does not become completely detached from the abdominal opening *a a*, a second sac *d*, may, occasionally, be formed beside the first.

Fig. 7. A loop of intestine, *b*, strangulated in the abdominal opening *a a.*

Fig. 8. A portion of intestine alone, strangulated in the abdominal opening *a a.*

Pl. 63

Fig. 1.

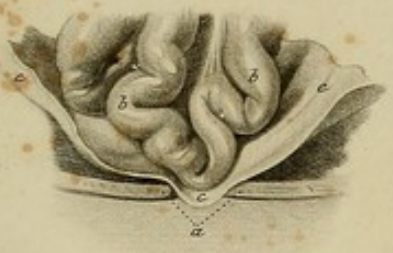


Fig. 2.



Fig. 3.

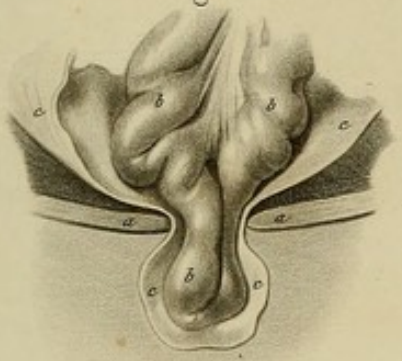


Fig. 4.

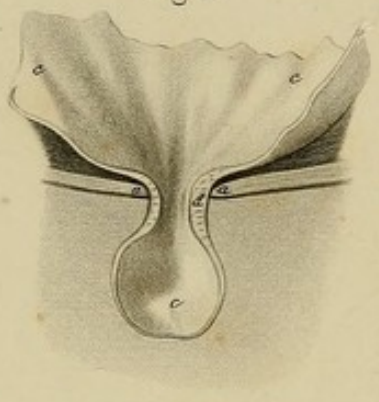


Fig. 5.

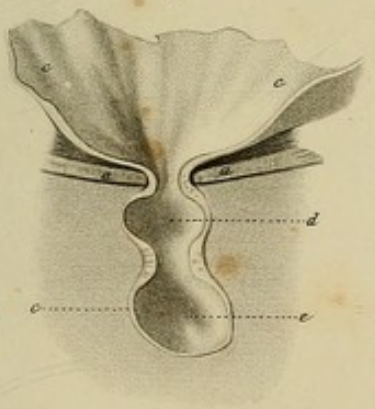


Fig. 6.

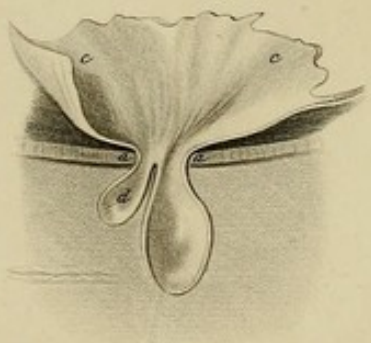


Fig. 7

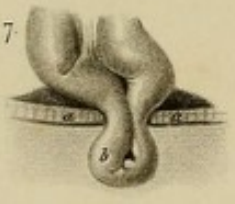


Fig. 8.



Pl. 64.

Fig. 1.

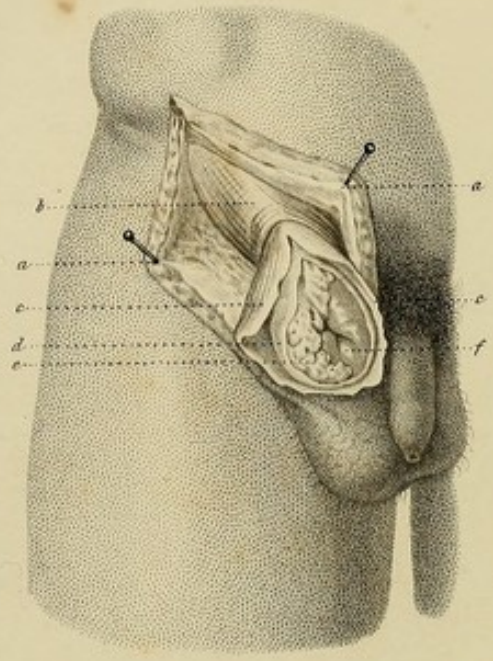


Fig. 2

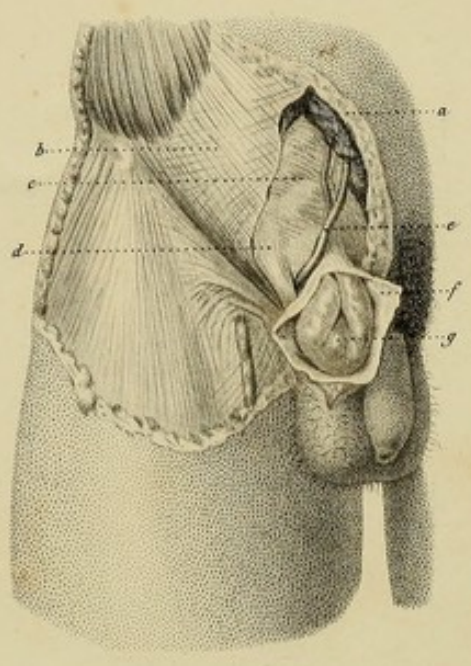


Fig. 3.

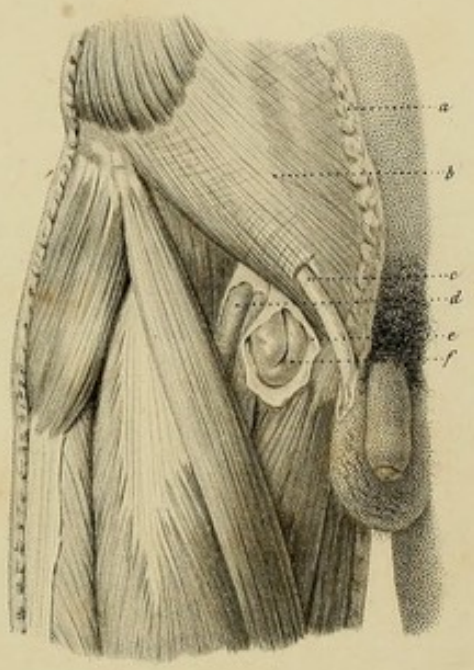


Plate LXIV.

SURGICAL ANATOMY OF HERNIA.

Fig. 1.—*Oblique, or indirect inguinal hernia, and its envelopes.*—An incision through the skin, the sub-cutaneous cellular tissue, and intercolumnar fascia *a a*, brings into view the tendon of the external oblique *b*, and the tunic formed by the prolongation of the fascia transversalis *c*, covered by the fibres of the cremaster muscle near their origin; beneath these lies the hernial sac *d*, formed by the peritoneum, inclosed in which is seen the omentum *e*, and a loop of intestine *f*.

Fig. 2. *Direct inguinal hernia.*—The skin and sub-cutaneous cellular tissue *a*, have been removed; a large portion of the tendon of the external oblique *b*, having also been dissected away, the peritoneum *c*, is exposed to view, and also the point where the spermatic cord *d*, takes its rise; the epigastric artery *e*, is also seen passing beneath the cord, and the hernial sac *f*, lying to the inner side of the epigastric artery, is laid open, showing its contents, a knuckle of intestine, *g*.

Fig. 3. *Femoral hernia.*—The integuments of the abdomen *a*, having been extensively removed, the tendon of the external oblique *b*, and the spermatic cord *c*, are exposed; beneath Poupart's ligament the femoral vessels *d*, are seen; internal to these vessels is a hernial sac *e*, laid open, and containing a loop of intestine *f*.

For the remainder of the anatomy of the inguinal region, refer to plates 16 and 17, with their descriptions.

Plate LXV.

RADICAL CURE OF HERNIA.

Fig. 1, 2, and 3. *Gerdy's method.*—Fig. 1. The surgeon is introducing the index finger of the left hand into the inguinal canal to force the skin of the scrotum up into it. A needle-holder *a*, passed along the finger to its extremity, is employed to perforate the bottom of the cul-de-sac thus formed, together with the anterior wall of the inguinal canal, from within outward, and to bring out above the first loop of thread *b*.

Fig. 2. The first loop of thread *a*, being detached, the needle-holder *a b*, is again passed through in another direction, by which means a second loop of thread *c*, is brought out below the first.

Fig. 3. Represents the loops, which have been cut, as tied over two little rolls of adhesive plaster, *a* and *b*, and the natural plug thus formed out of the skin of the scrotum, turned in upon itself like the finger of a glove, is held by these two double ligatures firmly fastened in the inguinal canal.

Fig. 4, 5, and 6. *Method of Bonnet, of Lyons.*—Fig. 4. A pin *a*, passed beneath the spermatic cord, is carried through the hernial sac.

Fig. 5. Two pins *a b*, are carried through the sac, one above and the other below the spermatic cord.

Fig. 6. The skin has been removed in order to show the position of the pins *b c*, relative to the spermatic cord *a*.

MODES OF OPERATING.

Compression.—This is effected by the application of an accurately fitting truss, which the patient should wear at all times, night as well as day. It may bring about a gradual obliteration of the hernial opening, and thus prevent any further protrusion of the intestine. This practice offers the greatest chances of success, when applied to young subjects.

The treatment should be continued for at least a year. Two or three years may even be necessary to obtain a satisfactory result.

Pl. 65.

Fig. 1.

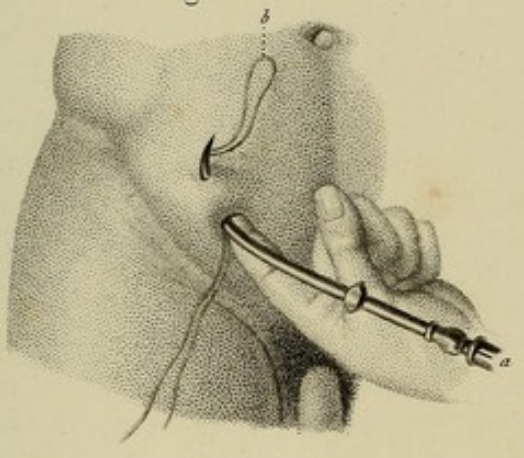


Fig. 2.

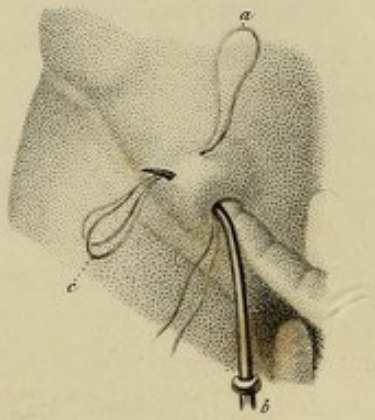


Fig. 3.

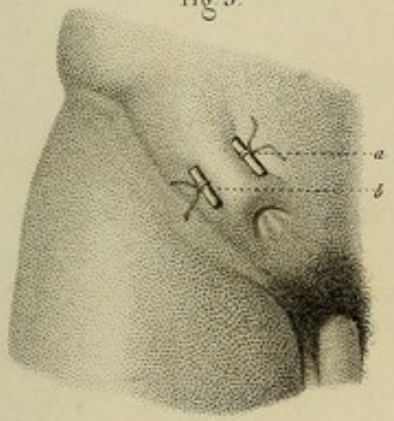


Fig. 4

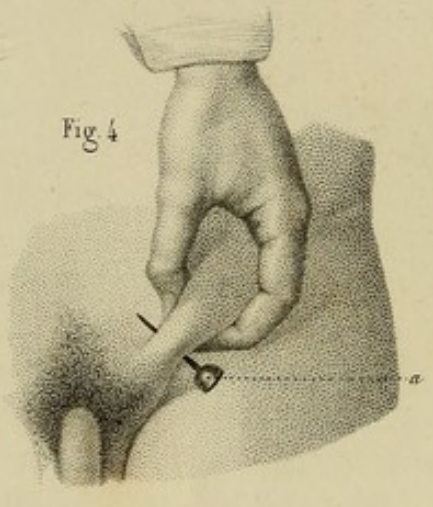


Fig. 5.

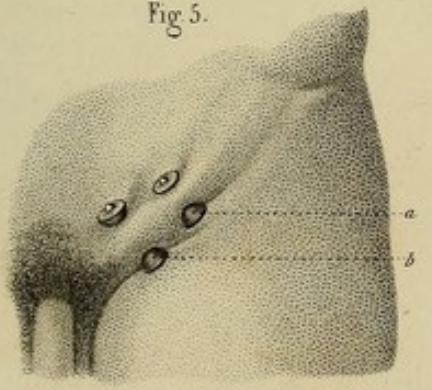
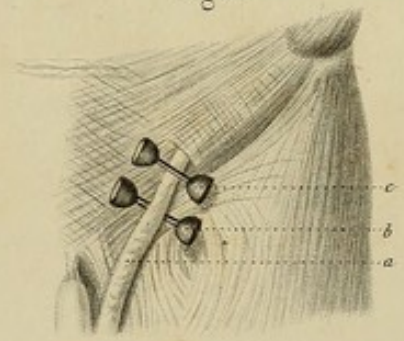


Fig. 6.



The surgeon should be particular regarding the shape of the pad of the truss, and the material of which it is composed, as it is important that the hernial opening should be very accurately closed.*

We shall limit ourselves to the mere mention of *cauterisation* of the neck of the hernial sac, as formerly practised by the Arabian surgeons; of *incision* of the sac, condemned by J. L. Petit and Pott; of the *incision* of the sac, as described by Celsus; of the *ligature of the neck* of the sac, for the purpose of producing mortification and sloughing of the hernial envelopes, etc. These modes have long since been abandoned. We shall confine ourselves to new operations.

Belmas' method.—The object of this operation is to obliterate the hernial opening by introducing a foreign body into the sac, which will create an inflammation of its walls.

The first method of Belmas consisted of the introduction into the sac, by means of peculiar instruments, of a small bag of goldbeater's skin which he blew up. This bag, filling up the sac, kept the hernia reduced, and produced an adhesive inflammation, which was followed by a complete obliteration of the hernial opening. For this mode, which is somewhat difficult of performance, Belmas has since substituted an analogous method, which is more easy of execution. Threads of gelatine are substituted in the place of the bag of goldbeater's skin; they produce an inflammation of the sac, the threads are absorbed, adhesion takes place, and the obliteration is thus completed. In ten cases thus treated, five were successful, three suffered a partial relapse, and two failed.

Gerdy's method (plate 65, fig. 1, 2, and 3).—This method is only applicable to inguinal hernia. It consists in obliterating the opening by means of a natural plug, formed from the skin which covers the hernia, which is fastened in its new position by points of suture. The surgeon forces up the skin of the scrotum through the external ring and into the inguinal canal, with the little, or index finger of the left hand (fig. 1); then, in his right hand he takes a peculiar kind of needle-holder (see Instruments, plate XV., fig. 6), and slides it along the finger which is thus forcing the skin into the inguinal canal; the extremity of the needle-holder carried down to the bottom of the cul-

* The truss, with a pad of wood, is undoubtedly the best instrument for the radical cure of hernia, as long since demonstrated by Dr. Chase, of Philadelphia, by whom this form of the instrument was invented.—Ed.

de-sac, is then, by a lever-like motion, made to cause a projection of the skin of the abdomen; the surgeon now pushing the slide, forces out the needle, which perforates the cul-de-sac and the anterior wall of the inguinal canal, and comes out externally in front. One of the loops of the double ligature contained in the eye of the needle is then secured by an assistant, and, the needle-holder still remaining in the cul-de-sac, the needle is drawn back into it, and again thrust through the soft parts, in a different direction, and brought out at a point below the first (fig. 2), and, the remaining end of the loop of thread being detached, the instrument is withdrawn.

The loop of thread thus retains in the upper portion of the inguinal canal a species of natural plug formed from the skin of the scrotum, which is thrust into the hernial opening like the finger of a glove turned in upon itself. The whole is made fast by tying the ends of the ligatures over two pieces of gum-elastic catheter (fig. 3). To produce obliteration of the cutaneous sac which has been thrust into the inguinal canal, Gerdy introduces into it a brush dipped in spirits of ammonia, which, producing inflammation, causes an adhesion of the walls of the cul-de-sac. A simple dressing is then applied, and the patient kept in bed during two or three weeks. Wounding of the peritoneum is one of the dangers of this operation. It has been followed by a fatal result.

Method of Bonnet, of Lyons (plate 65, fig. 4, 5, and 6).—Obliteration of the sac is here produced by means of pins passed through its walls. The hernia being reduced, the surgeon pinches up the parts at the root of the scrotum, so as to raise up the spermatic cord between the finger and thumb, and a pin, thrust through a small piece of cork, is passed through them and beneath the cord. The point of the pin is then thrust through another button-shaped piece of cork, and bent over it so that all the intervening parts are firmly compressed between these two bits of cork. A second pin is then inserted in the same way, but above the cord. Inflammation takes place in the course of four or five days. The pins are withdrawn between the sixth and twelfth day, and entire obliteration of the sac is effected in about a month.

Velpeau has employed injections of iodine and scarifications of the sac for the radical cure of hernia.

Summing up.—All of the operations proposed for the radical cure of hernia cannot be considered harmless; the advantages to be

obtained by their performance do not compensate the patient for the dangers to which he might be subjected. Prudent surgeons will not perform operations which are generally useless, and frequently dangerous, in cases where the hernia is inactive and threatens no immediate danger. Moreover, experience has proved that methodical and continued compression by means of trusses of proper construction, will frequently effect a radical cure of hernia.

Malgaigne has seen an inguinal hernia in an old man seventy-eight years of age cured in a year by simple compression, the inguinal canal being completely obliterated. There are facts enough of this character on record to justify the preference of a method which, on the whole, subjects the patient to no very great inconvenience.

GENERAL CONSIDERATIONS IN REGARD TO HERNIA.

We shall limit ourselves to the examination of inguinal, femoral, and umbilical hernia.

Every variety of hernia presents the following points for consideration: 1st, The nature of the organs protruded; 2d, Their envelopes, or the hernial sac.

The greater portion of inguinal, femoral, and umbilical hernias, consist of *omentum* and *small intestinc.* If the intestine alone be included (*enterocele*), the hernia forms a rounded tumour, varying in consistence, according as the intestine is full or empty; elastic, sonorous under percussion, if the intestine be filled with flatus, more or less soft if it be loaded with fecal matter.

When the hernia consists of the omentum only (*epiplocele*), it is soft, doughy, and uneven on pressure. Hernia of the omentum usually produces less annoyance of the digestive function than hernia of the intestine.

The hernia may consist of both intestine and omentum (*entero-epiplocele*).

We have exhibited in plates 63 and 64 the manner in which hernias are formed, and the various anatomical layers which constitute their coverings.

The investments, or coats of a hernia, then, are constituted by these several layers, which are pushed forward by the protruded organs The number and nature of these different envelopes vary according to the seat of the hernia, and they are subject to various modifi-

cations of structure according as the hernia is recent, or of long standing. We have described, layer by layer, the various parts which as a whole go to form the coats of a hernia; but these layers will not be found thus isolated when the rupture has existed for a considerable space of time; the inflammation to which they have been subjected has, as it were, glued them together, so that they form a dense, close mass, in which only two portions can be distinguished; the *neck of the sac*, that portion embraced by the abdominal opening, and the *sac* itself, which is the most developed. Internally, the sac proper consists of a serous membrane, the peritoneum, whose surface is smooth and polished; it is sometimes filled with serum; externally, the sac is more or less confounded with the sub-cutaneous cellular tissue. In the course of time, hernial sacs may undergo modifications of a nature to embarrass the surgeon; they may be thickened, ruptured, filled with serum, contract adhesions, inclose cysts in their walls, etc.

Hernias are either *reducible*, *unreducible*, or *strangulated*, with or without adhesions.

A hernia is called *reducible*, when the protruded organs can be easily returned into the abdomen. In these cases, the neck of the sac is large enough to allow the free passage of the intestines or omentum, which have contracted no adhesions with it, or with the sac itself. We shall consider, farther on, the method to be adopted in order to reduce a hernia (taxis).

An *unreducible* hernia is so called when the protruded organs have contracted adhesions either with the neck of the sac, or with the sac itself. It may happen that the sac has contracted adhesions with the adjacent parts; in such cases the intestine alone can be returned while the sac remains unreducible.

Obstruction.—When feces collect in the protruded intestine, and distend it, the hernia is said to be *obstructed*. This obstruction more frequently takes place in old persons, and when the rupture is of long standing and much dilated. Obstructed hernias rarely produce much pain, and have a doughy feel; but, when there is an accumulation of flatus, the tumour is sonorous when percussed. An obstructed hernia can generally be reduced by the taxis. But if the obstruction continues and the hernia remains for a long time unreducible, real strangulation may supervene.

Strangulation.—A hernia is said to be *strangulated*, when the

opening through which it has passed is too narrow to admit of its reduction, and it is becoming inflamed. This inflammation, the result of the strangulation, becomes itself a cause of constriction, by augmenting the volume of the parts which are protruded. A secretion of fluid takes place, and adhesions form at the neck and interior of the sac. The inflammation goes through its regular course and may terminate by gangrene of the hernia. Before mortification takes place, the surface of the intestine is of a violet color, owing to stagnation of the blood in the veins. A little later in the disease, this color becomes of a dark or chocolate color, and finally of a greyish ashy hue, when gangrene has occurred.

Seat of strangulation.—Richter believed that the tendinous rings were always the seat of the strangulation, and that a spasmodic contraction of them prevented the return of the hernia into the abdomen. But a more accurate study of the pathology of hernia has shown that in the great majority of cases the strangulation is produced by the neck of the sac. This last opinion is exclusively adopted by Malgaigne, who asserts that, when a real strangulation is present, the constriction is always found at the neck of the sac. Yet, many surgeons are of the opinion that the tendinous rings may be a cause of strangulation, which cause does not exclude the constriction produced by the neck of the sac.

It may happen that the constriction at the neck, which strangulates the hernia, is free in the abdominal rings; in such cases, if the hernia be reduced, the strangulation by the neck may continue within the abdomen.

The neck of the sac, and the tendinous rings, are not the only sources of strangulation. Bands in the interior of the sac, adhesions of the omentum, etc., etc., may exist, which can produce constriction, and prevent the passage of matters in the intestine.

Diagnosis.—As strangulated hernia may require the performance of an operation which is always serious, we will point out as concisely as possible the principal symptoms which characterise the three periods of this affection.

1st *Stage.*—An unreducible tumour, not large, painful to the touch; colicky pains diverging from the tumour into the abdomen; eructation and vomiting, first of food, then of bilious matter, and lastly of feces; constipation; meteorism and swelling of the abdomen. These symptoms may continue from a few hours to several days.

2d *Stage.*—Effusion of more or less serum into the sac; increase of inflammation and pain; the abdomen becomes painful on pressure, and the swelling is on the increase; nausea, vomiting as in the first stage; pulse small and frequent; face pinched and expressive of great uneasiness.

3d *Stage.*—Gangrene terminates the inflammation; the pain then ceases; hiccup takes the place of vomiting; the body is covered with a cold sweat; the features are altered; the pulse becomes small, thready and intermittent; the voice is broken; the tumour becomes of a dusky red color, and frequently crepitates under the fingers. The intestine may now be returned into the abdomen, and effusion taking place into the peritoneum is soon followed by death. In some cases, the tumour ulcerates and forms an opening externally. The open intestine adhering to the external wound, forms an *artificial anus* (see plate 67).

The picture which we have presented will enable the surgeon to determine upon the diagnostic differences between a simple hernial obstruction, and a case of strangulation where the operation is called for; we shall add nothing farther in relation to the history and pathology of the disease.

As a rule, the surgeon should always attempt reduction by the taxis before having recourse to the operation, especially if the strangulation be recent. But if the hernia be very painful and of long standing, it is better not to increase the inflammation by untimely manœuvres, and to perform the operation at once, lest its chances of success may be diminished by being deferred.

TREATMENT OF HERNIA.

The treatment of simple hernia may be either curative or palliative. The palliative treatment consists in avoiding the risk of accidents by applying a proper truss in such a manner that it will keep the hernia reduced under all circumstances.

The object of the curative treatment is to bring about an absolute removal of the disease.

We shall treat in another chapter upon the various manœuvres and operations (taxis, etc.), which hernias sometimes require.

Trusses (Instruments, plate XVIII., fig. 1, 2, 3, 4, 5, and 6).—A retentive bandage or truss, properly applied, keeps the parts accu-

rately and perfectly reduced, and thus prevents the occurrence of accidents which might complicate the hernia, such as unreducibility, obstruction, strangulation, etc. Trusses, also, when properly applied, may, under certain conditions regarding the age of the patient and the state of the disease, effect a radical cure of hernia. It is therefore important that the surgeon should be thoroughly acquainted with their proper form and dimensions, in order to be able to use them with the greatest possible advantage.

The only trusses in use at the present time are such as are made of a narrow strip of well padded elastic steel, which is covered with leather, and terminated by a pad, either fixed or movable, and of a shape which is varied to suit the case. Formerly soft bandages were used, made of leather, linen, or some other non-metallic substance. These bandages were fixed in their proper position by means of a belt made of some soft material, and the pressure required for keeping up the hernia was effected by means of a spring inserted into the pad.

The pads of spring trusses may be more or less soft. They are sometimes made of wood, ivory, India rubber, etc. The union of the spring or body of the truss is called the *neck*. Buttons are affixed to the plate to which the pad is attached, and are used to fasten the leather strap which extends beyond the steel spring carried around the body.

Another strap made either of leather or cloth, fastened to the posterior part of the truss, is brought from behind forward around the thigh, and attached to one of the buttons upon the pad plate. This last strap keeps the truss in place and prevents it from slipping up. There are also various kinds of trusses for double hernia.

The requisites of a good truss are: that it be appropriate to the height of the patient; and that it maintains a moderate and continuous pressure upon the tendinous ring, without giving annoyance to the patient.

Application of truss.—The patient is laid down upon his back and the truss carried around the pelvis; then after reducing the hernia, the surgeon keeps it in this condition by placing one hand over the inguinal or femoral ring, and now applying the pad exactly over this point, he retains it in this position by buttoning the leather belt to the back of the pad; he then carries the other strap around the thigh and also fastens it to the back of the pad. The patient then rises

and by walking about and making various movements of the limbs, enables the surgeon to see if the truss keeps the hernia firmly and properly in place.

When a truss is applied to a femoral hernia, the pad should be carried below Poupart's ligament. Malgaigne thinks that in some cases movable pads are decidedly better than those which are fixed; that, in oblique inguinal hernia, the pad should press on the course of the canal, and on the internal ring, and resting upon the pubis but slightly, if at all; that, in direct hernia, the pad ought to be larger, fixed, and resting upon the pubes; that hard pads are in general better suited for compressing the canal, and soft ones for direct hernia.

REDUCTION OF HERNIA.

Taxis.—The name of taxis is given to the various manœuvres by which surgeons effect the return of the protruded organs into the abdomen. Taxis is performed by means of the hands applied directly upon the tumour.

Position of the patient.—This should be such that the abdominal muscles will be in a state of complete relaxation. The patient should lie upon his back, with the head and shoulders slightly raised by means of pillows. The pelvis should also be elevated, so that the back will be in the most depending position, and the tumour somewhat raised as regards the abdominal cavity. The patient lying in this position, no pressure will be made by the intestines upon the ring through which the hernia is expected to pass. The thighs should then be flexed upon the pelvis, and the legs flexed upon the thighs.

General rules.—Before describing the special manœuvres required for the reduction of either variety of hernia, we will quote from Malgaigne the following general rules, which are applicable to the great majority of cases: 1st, Evacuate the bladder to augment as much as possible the capacity of the belly. 2d, Advise the patient to breathe freely, without crying out, or moving the head, in fact to keep as quiet as possible. 3d, Make but slight pressure at the commencement, in order that you may be able to increase it by degrees, and continue it longer without bruising the hernia. 4th, Return first the parts that last protruded. 5th, Return them in the same direction as they came out: for instance, in recent inguinal hernia, push the intes-

tine directly backward, until the external ring is passed, then backward, upward, and especially outwards along the course of the canal, and lastly from before backward, when you have reason to think that you have reached the internal ring. In congenital and long standing hernia, it usually suffices to push the parts backwards and slightly upwards to effect their reduction. 6th, Finally, in certain exceptional cases, these general rules fail, and the patients themselves have some peculiar method which they are in the habit of employing, which it is advisable for the surgeon to adopt.

Mode of operating.—The surgeon takes his position at the right of the patient, and embracing with one hand the base of the tumour, squeezes it gently with the other, with the view of distributing equally throughout the hernia the solid matter, or gas, which it may contain; this manœuvre exercising a general pressure towards the abdominal ring, would force the whole of the hernial contents towards the point of strangulation, and thus render the reduction impossible, if the surgeon did not take care at the same time to compress the pedicle of the hernia, in order to concentrate and contract the contents in them towards the ring; this last measure prevents the bearing down of the whole of the hernia at once upon the ring, but allows it to be drawn outwards, and gradually forced along in the direction of the canal through which it is to pass.

Compression may also be made upon the whole of the tumour, by applying the fingers over its entire surface. In some cases, those portions which lie next to the ring are returned in succession.

To aid in the reduction, the patient may be requested not to breathe, that in this way the action of the diaphragm upon the intestinal mass may be prevented. The application of large cupping glasses upon the abdomen has also been recommended.

It is very difficult, in an operation of this nature, for the surgeon to confine himself to one manœuvre exclusively. For the successful reduction of a hernia, he should try simultaneously, or successively, the various methods which have been described by authors for this purpose. The essential point is, to return the hernia in the same direction which it took when coming out. During the performance of reduction, the volume and hardness of the tumour may regularly diminish, and then suddenly return into the abdomen. This sudden reduction, which is accompanied by a gurgling sound, is the sign of

an intestinal hernia. Omental hernia usually returns gradually and without noise.

Continuance of the taxis.—The taxis, when continued too long, may impair the chances of success of the operation by the knife, which is required after the failure of the various means which have been tried to effect reduction. Amussat, however, recommends the continuance of the taxis for a long time, and presents a number of successful cases in support of his opinion. This question should not absolutely be decided *à priori*. The surgeon, therefore, taking into consideration the various circumstances connected with the accident, must regulate his proceedings accordingly.

Pl. 66.

Fig. 1.



Fig. 2.

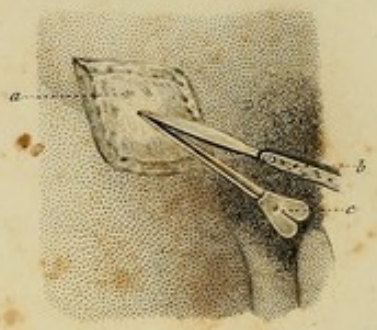


Fig. 3.

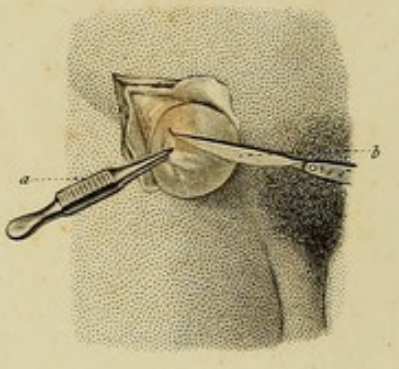


Fig. 5

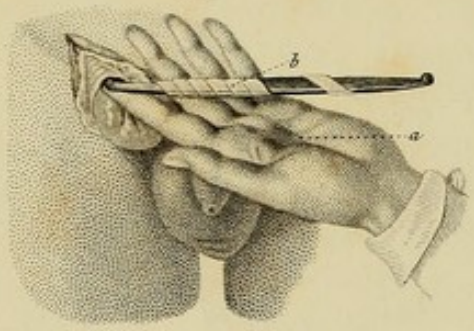


Fig. 4.

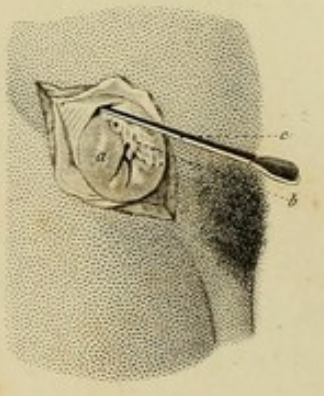


Fig. 6.

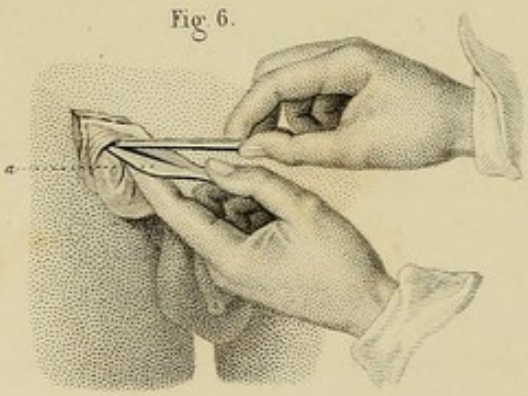


Plate LXVI.

OPERATION BY DIVISION OF THE STRICTURE.

Fig. 1. A fold of skin is pinched up over the tumour, and transverse to the direction of the fold of the groin. This fold of skin is held on the inner side by an assistant, and on the outer side by the left hand of the operator, while with the bistoury in his right hand he carefully divides it. This fold of skin may be divided from within outwards, by plunging the bistoury through its base, with its edge looking upwards.

Fig. 2. The first incision (fig. 1) should divide the skin and subcutaneous cellular tissue only. The lips of the wound being then held apart, the tumour *a*, covered by its several layers, is brought in view. The surgeon proceeds to divide these envelopes, layer by layer, with the bistoury *b*, which is slid along the groove of the director *c*.

Fig. 3. All the envelopes of the hernia having been successively divided, the surgeon now raises up a fold of the sac with the forceps *a*, and makes an incision in it with the bistoury *b*.

Fig. 4. The hernia *a* is fairly exposed; *b*, the omentum. A director *c*, is introduced between the hernia and the point of its constriction.

Fig. 5. *Division of the stricture.*—The surgeon having slipped one of the fingers of the left hand beneath the neck of the sac, slides along it a probe-pointed bistoury, a portion of whose blade is wound with linen; with this instrument he divides the stricture in a direction directly upwards.

Fig. 6. *Division of the stricture.—Vidal's method.*—The surgeon is introducing the bistoury along the grooved spatula, *a*, of a peculiar shape.

DIVISION OF THE STRICTURE OF INGUINAL HERNIA.

The operation for dividing the stricture of a strangulated hernia was first proposed and described by Franco, in 1561. It was adopted

and performed still later by Ambrose Paré, and was finally described and perfected, as a systematic operation, by Dionis.

The *instrumental apparatus* consists: of an ordinary straight bistoury, a scalpel, a straight probe-pointed bistoury, or the hernial bistoury of Pott, or Astley Cooper. These bistouries have been modified in various ways (see Instruments, plate XVI., fig. 2, 4, 5, 6 and 7); a director; a pair of blunt scissors, and, also, dissecting forceps. Several fine sponges are also necessary to staunch the blood which escapes during the performance of the operation, and lastly, various kinds of dressing; such as perforated linen, lint, compresses, bandages, cerate, etc.

The *position of the patient* should be such that the abdominal muscles are in a complete state of relaxation. He should therefore be laid horizontally upon the back, the shoulders slightly elevated by means of a pillow, the thighs partially flexed upon the body, and the legs flexed upon the thighs. The groin should be shaved if required. The operator then takes his position on the right of the patient, having the necessary assistants by his side and opposite him, whose duty is to hand the instruments, sponge away the blood, and to render such other aid as may be required during the performance of the operation.

This operation, whose object is to relieve the strangulation by dividing the stricture which produces it, consists of several steps in which the surgeon incises successively: 1st, The skin; 2d, The subcutaneous envelopes of the hernia; 3d, The hernial sac; 4th, The stricture; and 5th, Effects the reduction of the viscera, which concludes the operation.

1st *Stage.—Incision of the skin* (plate 66, fig. 1).—The incision should be made in the direction corresponding to the greatest diameter of the tumour, and proportionate to its volume. It may be made either from within outwards, or in the opposite direction, when the skin is intimately united to the envelopes of the hernia, and cannot be raised up in a fold by itself. In this case, it should be divided cautiously, slowly and very little at a time. The essential point is not to wound the intestine. When the skin is pliable and not adherent, or but slightly so, to the parts beneath, it is preferable to raise up a fold of it over the tumour. An assistant, holding one end of this fold, the surgeon lifts up the other and divides it either from without inwards or from within outwards, which last incision is

effected by plunging the bistoury, with its edge looking upwards, through the base of the fold.

This first incision is only carried through the skin, and should extend about half an inch above and below the tumour. It is sometimes necessary to make a crucial, or T shaped incision.

After the incision of the skin some hemorrhage takes place from the divided superficial arteries; this is usually trifling in amount, and rarely requires the employment of a ligature.

2d *Stage.—Incision of the sub-cutaneous envelopes of the sac.*—In this stage great caution and delicacy of hand is required. Some surgeons make the incision directly from without inwards, by holding the scalpel like a pen, and carrying its edge directly over the tumour. The safest way is to raise up with the forceps each layer which covers the hernia and incise it to a limited extent horizontally and obliquely; then introducing a director through the small opening thus made, insinuate it beneath the layer to the extremity of the tumour, and sliding the bistoury with its edge upward along the groove, divide it surely and safely. Divide in the same manner, one by one, all of the several layers of the hernia, down to the sac. Blunt scissors may also be employed for the same purpose. The number of the envelopes varies. We have enumerated and described them in our account of the surgical anatomy of the inguinal and femoral regions. But the long standing of a hernia, the duration of its strangulation, etc., so modify the nature and relations of these envelopes, that their anatomy in the healthy state will no longer serve as a guide to the surgeon, and he will frequently find it extremely difficult to recognise the sac itself among the abnormal layers produced by disease. Serous cysts, lumps of adipose matter, suppurating lymphatic glands, an old sac, etc., etc., may obscure the operation, and give rise to hesitation and doubt in the mind of even the most experienced surgeon.

Yet there are certain signs by which the sac can be recognised; these are, its smooth and polished surface, spherical form, the fluctuation—which indicates the presence of serum, and its transparency—which enables the surgeon to recognise the intestine or omentum, etc.

3d *Stage.—Incision of the sac* (fig. 3).—The sac being recognised, great caution should be used in opening it, to avoid wounding the intestine. To effect this, the surgeon, with a pair of forceps, takes up a fold of the sac lying between the circumvolutions of the intestines which are seen beneath, or rather opposite the omentum; this portion

of the operation is rendered easy in the great majority of cases, owing to the serum which distends the interior of the sac. A slight opening, close to the jaws of the forceps, is then made in this fold of the sac, and the director introduced through it, upon which the surgeon proceeds to divide the sac, first upwards, and then downwards, throughout its whole extent. This opening should be made as nearly as possible in front, and a little to the outer side. The surgeon should then satisfy himself that the sac is really laid open. The following signs will prove undoubtedly this fact: The escape of a quantity of serum after the incision, the facility with which the finger or director can be carried in every direction through the sac when there are no adhesions, and the free floating of the intestine and omentum, which are only adherent at a point corresponding with the abdominal ring. We should add that some hernias, the hernia of the cœcum, for instance, have no sac. When this peculiarity, which is very rare, presents itself, the intestine is easily recognised by the structure of its coats.

In the majority of cases, the color of the intestine varies according to the length of time which it has been strangulated. Its surface is vascular; its more or less deep reddish brown color may be masked at some points by a layer of plastic lymph. The omentum may be slightly unfolded when it has contracted no adhesions. Figures 4, 5, and 6, represent a fold of intestine, as it appears after the opening of the sac.

4th *Stage.—Division of the stricture.*—Before performing the operation for division of the stricture, the surgeon should introduce his finger and examine the neck of the sac, and carefully execute such manipulations upon the protruded intestine as will favor, if possible, its reduction without having recourse to the knife.

The seat of the stricture being satisfactorily recognised, and its division being deemed indispensable, the operation can be performed by either of the two following methods: 1st, By the division of the stricture to a proper extent on the side opposite to that upon which the vessels are located; 2d, By making several incisions at different points of the seat of strangulation; these incisions, which are numerous, but very short, have been reduced to a method by Vidal (de Cassis).

The stricture is divided with a probe-pointed bistoury, either straight, convex, or concave. In plate XVI., we have exhibited the

principal models of instruments recommended for this purpose. The straight probe-pointed bistoury (plate 1, fig. 3), is generally preferred; the blade is wound with adhesive plaster, to within half an inch of the point, leaving just sufficient of the edge bare to divide the stricture. The instrument may be slid along the index finger, or the groove of the director (fig. 4 and 5). When the finger cannot be carried up as far as the point of stricture, the director must be used; but if the nail can be insinuated beneath the constriction, the bistoury, laid flat upon the finger, should be slid along it until it has passed under the point of stricture, when its edge being turned upward, by the pressure of the finger upon the back, the stricture is divided. The index finger may then be introduced still farther, and, if necessary, the incision enlarged. During this portion of the operation, the assistants separate the lips of the wound, and draw aside the intestines, which, if allowed to come in contact with the instrument, might either be wounded, or embarrass the surgeon.

Vidal has invented a grooved spatula along which the bistoury is carried (Instruments, plate XVI., fig. 3). This spatula is particularly useful when the surgeon cannot follow with his eye the course of the instrument. The tip of the spatula is first inserted between the hernia and the stricture. The grooved face of the spatula is turned upwards, or towards the point of strangulation, and the bistoury, lying flat, is so slid along this face that it can do no injury to the adjacent parts. When the stricture is reached, the knife is turned upon its axis so as to bring the edge upward, and the division is effected by scraping as well as cutting. This spatula intervening between the knife and the intestines, protects the latter from injury.

We have said above that it was advisable to attempt to effect reduction before having recourse to the division of the stricture; but it must not be forgotten that the seat of strangulation is more frequently in the neck of the sac than at the tendinous rings. In some cases the hernia might be reduced along with the sac, but strangulation by the neck of the sac might still continue although the whole was returned into the abdomen. The surgeon should therefore ascertain beyond a doubt the exact seat of the strangulation. It should not be forgotton that some hernial sacs have several necks, and that the seat of strangulation may be very much extended, reaching even as far as the internal abdominal ring. It is only by cautious examination, and even successive divisions of strictured points

the surgeon becomes fully aware of all the difficulties which may complicate the operation.

Authors are divided in opinion regarding the direction and extent of the incision to be made for relieving the stricture. When the external ring is the seat of strangulation, and the neck of the sac can be drawn out of the inguinal canal, the division of the stricture is always easy, and there is no danger of wounding the epigastric artery. But when the stricture is higher up and the surgeon cannot ascertain if the hernia be direct or indirect, great prudence must be exercised.

We refer to plates 60, 61, and 64, for the description of these important anatomical relations. By dividing the stricture directly upward there is less risk of wounding important organs. By limiting the incision to some two lines in length there is no danger of wounding the artery. When the hernia is oblique, the incision, if made to the outer side, can be carried farther without danger, the extent being always proportioned to the organs to be reduced. To effect this result, it is frequently preferable to have recourse to the operation by several incisions which has been recommended by Vidal.

Division of the stricture by several incisions.—In cases where it is necessary to enlarge the abdominal opening considerably, instead of making one large incision, which would increase the risk of hemorrhage, Vidal makes three, four, or even more, each from one to two lines in length.

Malgaigne's method.—Malgaigne makes the incision, not along the sac and scrotum, but upon the exact spot where the strangulation appears to be, and prolongs the incision above and below, according to the fatness of the patient, and the size of the hernia. All the tissues are thus divided down to the peritoneum, and there is nothing to fear from the vessels as the surgeon has them under his eyes, and can put them to one side or the other as may be desirable. If the strangulation is caused by the fibrous rings, the surgeon need not touch the sac, and may reduce the hernia. But if this is not the case, he divides the neck from without inwards, by very slight and cautious incisions; or rather, if the stricture appears to be very strong, he makes a small incision in the peritoneum, either above or below the neck, and slides a director beneath it, upon which he completes the incision.

Malgaigne asserts that his method has this advantage,—that it

enables the surgeon to see everything as he goes on; and secondly, that the stricture is reached by the shortest route, and the least amount of cutting; and thirdly, that it does not include the scrotum and sac, and thus avoids making a wound which is useless at best, and whose suppuration and cicatrization is only an additional complication. As a recommendation of his method, Malgaigne cites the case of a very large scrotal hernia, in which he performed this operation. The neck was situated on a level with the abdominal ring; the neck was opened, and during the first few days after the operation the sac filled up with a quantity of fluid, which was gradually absorbed as the inflammation of the wound above diminished, and the patient recovered without further inconvenience. (MALGAIGNE'S *Operative Surgery.*)

5th *Stage.—Reduction.*—In cases of intestinal hernia, when the intestine itself is healthy, it should be drawn out a little in order to break up such feeble adhesions as may exist; by moderate pressure, the gas contained in the intestines can be forced into the abdomen, and the reduction gradually effected by first returning those portions which lie immediately adjacent to the ring. When a part of the omentum comes down with the intestines, it should be the last returned.

When gangrene has attacked any portion of the intestines, the treatment varies according to the extent of the gangrene. If there be any doubt concerning the presence of gangrene, Vidal advises the surgeon to remove with the bistoury a very small and thin slice of the intestine at the diseased point. If the circulation be still active, a large drop of blood will immediately form on the wound; but if, on the contrary, the intestine is gangrenous, the wound will remain dry; if the first condition exists, the intestine should be returned; if the second, it should not be reduced. When there is a doubt, the part supposed to be gangrenous should be retained at the wound. If gangrene be present, the fecal matters can be expelled at the opening in the abdomen. It may happen that the intestine has been perforated by the bistoury; in such cases, the surgeon should be governed by the nature and extent of the wound, and have recourse to one or other of the methods which we have described above (wounds of the intestines). Finally, when the intestine is gangrenous to a great extent, the surgeon should fasten the ends, both above and below which are healthy, to the ring, to facilitate the passage of fecal matter by the

upper end of the gut and the external wound, thus establishing an artificial anus, which can be cured, if desirable, at some future time. It may perhaps be possible to remove the gangrenous portions entirely, and bring the healthy parts together by means of sutures, and then return the intestine.

Whenever it becomes necessary to establish an artificial anus, care must be taken not to break up the adhesions which may exist between the end of the intestine and the neck of the sac; for the destruction of these adhesions would render the intestine liable to return into the abdomen. If the strangulation prevents the fecal matter from escaping freely externally, a female catheter may be introduced into the upper end of the intestine; but if this introduction be impossible or dangerous, owing to the presence of adhesions which ought not to be broken up, the surgeon should carefully incise the sac to the outer side.

Gangrene of the omentum requires a different treatment, according to the extent of the disease and the quantity of the omentum protruded. When the disease is extensive, the omentum should be unfolded and the diseased portion all removed down to the sound parts; the bleeding vessels should then be tied one by one, and all this portion of the omentum fastened at the opening of the ring.

Dressing.—After thoroughly cleaning the bottom and lips of the wound, a piece of perforated linen spread with cerate should be applied over it; upon this piece of linen, lint enough should be laid to fill up the wound, and over all a few compresses, which are held in position by means of a *spica bandage*, thus completing the dressing. [In this country the lips of the wound are generally brought together by sutures, unless an artificial anus is inevitable, and immediate union effected—appropriate pressure being effected by bandages.—Ed.]

FEMORAL HERNIA.

In plates 60, 61, and 64, and the description which accompanies them, we have pointed out the principal anatomical relations of femoral hernia.

When the cœcum, or the sigmoid flexure of the colon protrude where they are uncovered by peritoneum, they form a hernia without a sac. With this exception, femoral hernia consists of very much the same elements as inguinal hernia. At first, it takes its direction downwards in the sheath of the femoral vessels, then passes through the cribri-

form fascia, when its course changes and it mounts up towards the abdomen, beneath the skin and the laminæ of the sub-cutaneous cellular tissue. In the great majority of cases, the neck of the sac is formed on a level with the opening through the cribriform fascia, and here also is the seat of strangulation, when it is produced by the tendinous ring of the cribriform fascia. But when the strangulation takes place at the superior orifice of the canal or in the canal itself, the neck of the sac is the cause of stricture. (MALGAIGNE.)

The remarks which we have made concerning taxis, as employed in inguinal hernia, are also applicable to femoral hernia. We will only observe that the protruded parts must be returned by following the various windings of the canal.

Division of the stricture.—The surgeon may make a simple incision, or one in the shape of an inverted T, according to the nature of the case; the main incision should be parallel to the largest diameter of the tumour. As the various tissues which cover the hernia are thin, the surgeon must proceed with caution, it being frequently impossible to raise up a fold of skin over the tumour. The layer which immediately covers the sac is very thin, and may be mistaken for the sac itself; little lumps of fat, sheathed in the sac, and seen through that layer, may be mistaken for the omentum, and give rise to a fatal error. It is therefore necessary for the surgeon to proceed with caution in incising the coverings of the hernia, in order to avoid the error of attempting to divide the stricture before opening the sac, when it is formed in reality by the neck of the sac itself.

The recent researches of modern surgery have induced surgeons to abandon the modes of dividing the stricture which were formerly described by authors. Demeaux has demonstrated that the seat of strangulation is at the tendinous ring of the cribriform fascia, at which point the neck of the sac in this variety of hernia is never the cause of stricture. The stricture may therefore be divided upward and outward with safety; if the incision were made in a downward direction there would be danger of wounding the saphena vein. If after the division of the tendinous ring, the surgeon concludes that the strangulation is caused by the neck of the sac, he can draw this out and readily divide it.

Taxis and bandages.—This variety of hernia may be easily reduced by means of the taxis, when it is maintained in its proper position by means of peculiar kinds of trusses or bandages. In children, a few discs of cork are applied which are kept in position by a bandage around the body, by which means a *radical cure* is easily obtained. Ligature of the sac has also been proposed. This method, which has been successfully practised by Desault and Dupuytren, has been disapproved of by Sabatier, Scarpa, and Astley Cooper, who have asserted that it produced convulsions in children, and also inflammation of the sac.

Division of the stricture.—Umbilical hernia may be either obstructed, or strangulated, and require an operation for the division of the stricture. It must be remembered that the envelopes are very thin, and that the sac contains little or no serum, which facts render the operation delicate. The surgeon then very cautiously makes a crucial incision, +, or one in the form of a T. As umbilical hernia is very rarely strangulated by the neck of the sac, some authors have advised that the fibrous ring alone should be divided, without touching the sac, in order to avoid the risk of a consecutive inflammation of the peritoneum; a good recommendation, which should be followed when the hernia is large, and it is not necessary to lay bare the viscera. Division of the stricture by several small incisions is preferable to one large incision, but if a single incision is employed it should be directed upward, and to the left side, in order to avoid injuring the remains of the urachus and the umbilical vessels.

Pl. 67

Fig 1.



Fig 3.

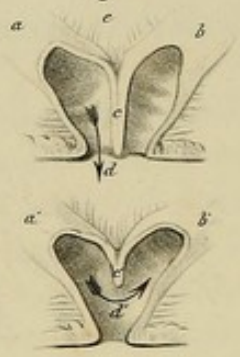


Fig 2.



Fig 4

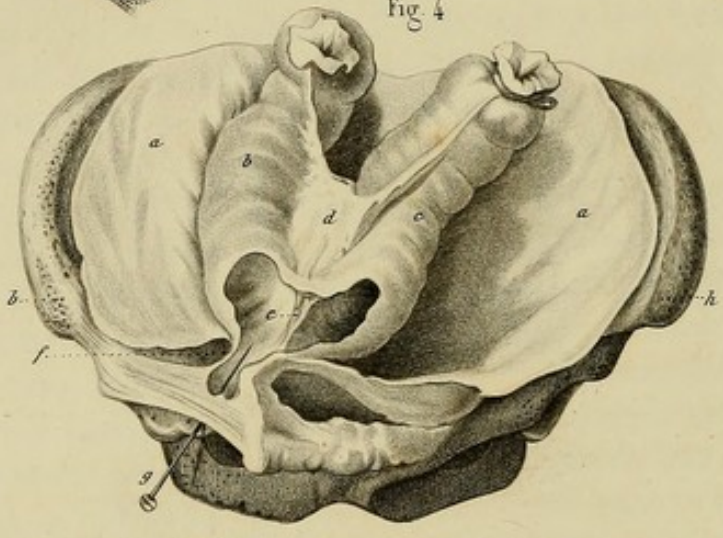


Fig 5

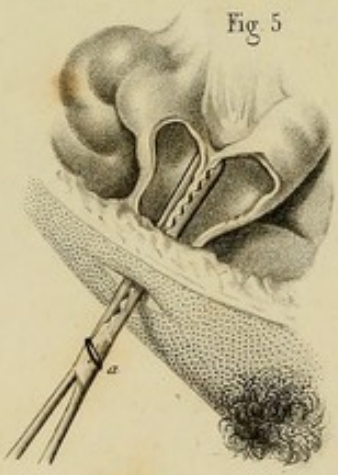


Fig 6.

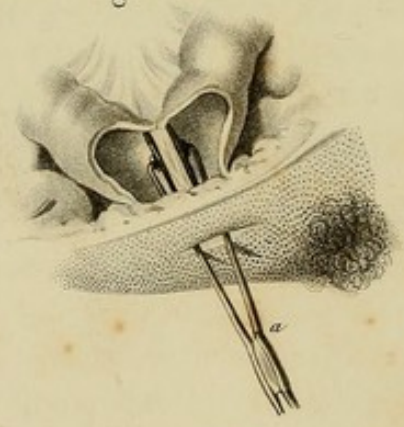


Plate LXVII.

ARTIFICIAL ANUS.

Fig. 1. *Artificial anus, opening externally by two orifices.*—The upper portion of the intestine, *n*, and the lower portion, *b*, open at the groin, each by a separate orifice in the skin, *d* and *e*; *c*, the mesentery.

Fig. 2. *Artificial anus, opening externally by a single orifice.*—*a*, the upper portion of the intestine; *b*, the lower portion terminating by a cul-de-sac; *c*, partition formed by the contact of the walls of these two portions; *d*, the external orifice of the upper portion.

Fig. 3. *Theoretical figure, representing the formation of the partition.*—*a*, the upper end; *b*, the lower end; *c*, the partition formed by the contact of the walls of these two ends; *e*, the mesentery; *d*, the external orifice of the upper end.

In this figure the partition, *c*, reaching as far as the external orifice, *d*, prevents all matters from passing into the lower end, *b*, and directs them externally in the course of the arrow.

Fig. 3 *bis. Theoretical figure, showing the formation of the funnel-shaped opening.*—The mesentery, by drawing the partition *c'* inwards, leaves the passage free from the upper into the lower end of the gut. The space, *d'*, lying between the partition and the external orifice, has been described by Scarpa under the name of the *membranous funnel.*

Fig. 4. *The membranous funnel, after Scarpa.*—*a a*, the peritoneum; *b*, the upper end of the intestine; *c*, the lower end; *d*, the mesentery; *e*, the partition. A stylet, *g*, is introduced through the cutaneous orifice into the membranous funnel; *f*, its external wall; *h h*, anterior-superior spines of the ilium.

Fig. 5. *Application of Dupuytren's enterotome.*—The instrument *a*, is introduced through the external wound, and the partition grasped between its jaws.

Fig. 6. *Application of a circular pair of forceps, a, for incision of the bowel.*

ARTIFICIAL ANUS.

PATHOLOGICAL ANATOMY.

(*Plate* 67.)

Whilst speaking of the various accidents which are liable to result from a strangulated hernia, we mentioned that it might terminate in gangrene of the intestine, producing ulceration of the tumor, and giving passage externally to fecal matters through a fistulous opening in the fold of the groin. This opening, becoming permanent, and permitting constantly the free passage of the fecal matter, forms that variety of disease to which the name of *artificial anus* has been given. We shall proceed to describe the various surgical operations employed in the treatment of this disease, and also describe further on the operation for *artificial anus*. The condition of the intestine, both above and below the opening, should be thoroughly ascertained, for upon it the curability of the disease depends. Sometimes, the artificial anus consists of a number of small external openings, at a variable distance from the intestine; in other cases, the walls of the upper and lower end of the gut lie in contact, and parallel to each other, and open externally by two distinct openings. Fig. 1, plate 67, exhibits this arrangement: *a*, the upper end; *b*, the lower end; *d* and *e*, the two external openings, corresponding to the two ends of the intestine.

The upper end of the intestine may communicate externally by a single opening (fig. 2, *d*) and the lower end *b*, agglutinated, but separated from it, by the septum *c*.

It is important that the surgeon should be familiar with the arrangement presented in fig. 3, where the walls of both ends of the intestine are brought closely in contact. These walls *c*, form a species of valvular septum, which prevents the free passage of the fecal matter from the upper end *a* into the lower end *b*. This septum is called by the French *l'éperon*, or the *spur*. We shall describe farther on the

various methods which have been adopted for destroying this spur, or projecting partition, and thus allowing a free passage of the feces from the upper into the lower portion of the intestine.

Membranous funnel.—The mesentery, in consequence of its connection with both ends of the intestine, always tends to retract them into the abdomen, by drawing them away from its parietes. The projecting partition or spur, as well as the intestine, under the influence of this constant traction, has a tendency to increase its distance from the external abdominal opening. The cellular tissue which unites the external opening with the intestine, yields by degrees (fig. 3, *d*), and the feces thus pass by the projecting spur into the intestine below, without meeting with any obstacle from it, or escaping externally. The fecal matters thus passing without difficulty from the upper into the lower portion of the intestines, the disease cures itself. Scarpa has given the name of *membranous funnel* to this space between the ends of the gut and the external opening, which, forming by degrees, naturally and gradually effects a cure of the artificial anus. We have borrowed from Scarpa a design (fig. 4) which exhibits this membranous funnel.

Our previous remarks show the importance of ascertaining the condition of both ends of the intestine. Their condition, in fact, should serve as a basis upon which the surgeon makes choice of the method of treatment to be adopted.

MODES OF OPERATING.

Palliative treatment.—The object of this mode of treatment is to regulate and modify the evacuation of the fecal matter, and to prevent any accidents which might result from the obliteration of the opening through the abdominal walls. *Dilatation* of the opening and of the upper end of the intestine, may be effected by means of lint tents, by some species of dilatable roots, pieces of prepared sponge, &c. A variety of plugs have been invented, whose form varies according to the nature of the case. The edges of the opening may be supported by means of a wooden or ivory disc, with an opening in its centre, which can be opened or closed at pleasure. Communication between the two portions of the intestine may be kept up by means of a large gum elastic catheter, one extremity of which is inserted into the upper and the other into the lower end of the intestine; the fecal matters

thus pass readily from one portion of the intestine to the other through this duct. We shall not enter into a detailed description of all the instruments which have been invented for this palliative treatment. None of them answer fully the proposed end, and the disease itself threatens so many serious dangers, that it is better to have recourse to some mode of treatment which promises to effect a radical cure.

Curative treatment.—Before attempting to produce an obliteration of the abnormal anus, the surgeon should first direct his attention to the treatment of the complications which so often accompany this disease.

When there are several openings in the skin, they may all be united into one. Sometimes there is a protrusion of the intestine and eversion of its mucous membrane; in such cases, the surgeon must reduce the tumour, by making methodical compression upon it from its apex to its base. Reduction of the intestine may be impossible; in such cases, the operation may be facilitated by enlarging the abdominal orifice, by means of several short incisions through the skin down to the peritoneum. Dilatation may also be employed successfully in cases where the abdominal opening is too small. These different complications frequently require a long continued treatment, which being successful, the surgeon then proceeds to destroy the projecting spur, if one exists, in order to facilitate the passage of the feces from one portion of the intestine to the other, and to obliterate the external opening.

Destruction of the projecting spur.—Desault's method.—Desault commenced by dilating both ends of the intestine by means of lint tents, which he regularly increased in size. Fifteen days were frequently required to produce a satisfactory dilatation, which being effected, he inserted a conical plug into the opening, thus forcing the spur back towards the abdomen, and leaving the two ends of the intestines opposite to each other. When the feces passed freely from one portion of the intestine into the other, slight compression, on the external opening only, prevented the passage of all matters externally, and cicatrisation was gradually produced. Desault also used an ebony cross to push back the spur. Both of these methods may produce distention of the abdomen, colics, the retention of the feces, and other symptoms.

To avoid preventing the passage of the feces, Fayet, and still later, Colombe, proposed to use a gum-elastic catheter of large size, in place

of the plug and ebony cross. The body of the catheter compressed the spur, while its extremities, inserted in each portion of the intestine, allowed the free passage of the feces. This method was adopted by Velpeau, but the patient died of peritonitis three days after.

Compression, as Vidal de Cassis judiciously remarks, is not sufficient; it cannot be methodically performed, for a fulcrum on the abdominal side is wanting, and as the spur is not placed between the force applied and a corresponding resistance, the result is, that it is not really compressed, but only pushed backward. If the force is increased, the compression may be dangerous, for the adhesions, being pulled upon, may be broken up.

Incision of the bowel (*Enterotomy*).—The object of this operation is the removal of the projecting partition between the open ends of the bowel. It was first described by Schmalkalden, in 1798. He passed a needle armed with a thread through the base of the spur, and by tying the two extremities of the thread, effected its removal by ligature. In 1809 this operation was successfully performed by Physick.

Dupuytren's method.—The operation of enterotomy was systematized by this surgeon. Fear of perforating the intestine with the needle suggested to him the idea of producing adhesion between the walls of the bowel lying in contact with each other and forming the spur.

He employed a variety of forceps, to which the name of *enterotome* was given (see Instruments, plate XV., fig. 7). He compressed the spur between the jaws of the forceps, and gradually increased the compression, until its vitality was destroyed by the process of sloughing.

The enterotome consists of two distinct branches, which can be introduced separately, one into the upper, and the other into the lower portion of the intestine. These branches are joined together in the same way as obstetric forceps, and tightened by means of a screw attached to the handles. The pressure of the forceps produces, first, adhesion of the walls of the intestine which lie in contact, and afterwards, division of the part compressed. The instrument should be allowed to remain for several days, and is fixed in position by means of bandages, which prevent it from moving about and producing a

painful, dragging sensation upon the intestines. In the course of seven or eight days, the division is completely effected, and the instrument detaches itself spontaneously.

Delpech invented an enterotome whose jaws were terminated by undulations resembling the half of a walnut shell. The extremity of these forceps is larger than those of Dupuytren, and more difficult of application.

Listard has invented an instrument, which is terminated by two oval rings, an inch and a third in length, by two thirds of an inch in width; one of these rings has a groove around its margin for receiving a corresponding projection of the other. The branches touch only at the rings, which are applied upon either side of the projecting partition, so as to detach a portion of it, and thus give passage to the feces without allowing them to escape externally.

Jobert thinks the enterotome should be applied only for the purpose of producing adhesions. In the course of forty-eight hours adhesions are generally formed; the instrument should then be withdrawn, and after waiting a day or two longer for union to become more firm, the surgeon should excise the septum with the scissors, taking care, however, to keep within the limits of the adhesions.

Cauterization.—Vidal de Cassis recommends the use of caustic instead of the enterotome. Two little excavations are made in each blade of a pair of forceps, which are filled with the nitrate of silver, or better still, with Vienna paste. Thus applied, the action of the caustic is rapid, but limited in extent; the operation can be easily executed, and there are no instruments remaining in the wound after its performance: the eschar gradually detaches itself, and the ulceration which remains will secure a free passage for the feces.

Obliteration of the external opening of the abnormal anus.—The projecting partition being destroyed, and free communication established between the two portions of intestine, the opening through the walls of the abdomen must now be closed,—a proceeding frequently difficult to effect. Autoplasty has been frequently tried, but without success. Velpeau tried excision and union of the edges of the wound by suture, in a patient upon whom he operated in 1835. He thus describes the operation:—"I included the whole of the fistula in two semi-lunar, elliptical incisions, oblique from the sides towards the centre, avoiding, at the same time including the intestine, or at least

its mucous membrane, in the incision. I then inserted four points of suture, each two lines from the other, taking care that no portion of them entered the abdominal cavity, or the intestine. An incision two inches and upwards in length, through the skin, the sub-cutaneous layer and the tendon of the external oblique, was then made on each side, about an inch beyond the limits of the wound. Having then thoroughly washed and cleansed the wound, I tied the threads and put a cylindrical piece of lint into each of the external wounds to keep their edges apart, before applying the dressing."

In this method, by paring off the edges of the fistula, it was changed into a deep, funnel-shaped opening, whose greatest dimensions were external; in bringing the opposite sides of the wound together, its deeper portion, which is the narrowest, should be brought in apposition before the lips of the external wound are in contact. This is in fact the result which is sought for, the closure of the opening in the intestine being rapidly effected. The lateral incisions serve to relax the skin so that the edges of the wound are easily brought together.

Malgaigne's method.—Malgaigne thinks that surgeons have not completely recognised the principal cause of the difficulty which has been experienced in closing some varieties of abnormal anus, while others are obliterated by the efforts of nature alone. In the first, the intestine is prolonged as far as the opening in the skin, and its valves direct the fecal matters towards this orifice; it is therefore almost an indispensable condition of success to change this position of the intestine, and give its valves a different direction. For this purpose, Malgaigne performed the following operation upon a patient with complete success:

The edges of the abnormal passage are removed through their entire thickness down to, but not including, the intestine, which is carefully separated from its external adhesions, recollecting, however, that these adhesions sometimes extend but a short distance, and that in separating them more than the third of an inch there might be danger of opening the peritoneum. Then both lips of the intestine are turned inwards without paring off their edges, and united by means of the quilted suture, so as to bring their external surfaces in contact. Over this first suture, the integuments are then brought

together by means of the twisted suture, care being taken to prevent dragging upon the parts. If there be a loss of substance, recourse must be had to autoplasty. The essential part of this method consists in isolating the intestine, and turning its lips inwards, then closing the external wound over it.

Pl. 68.

Fig 1.

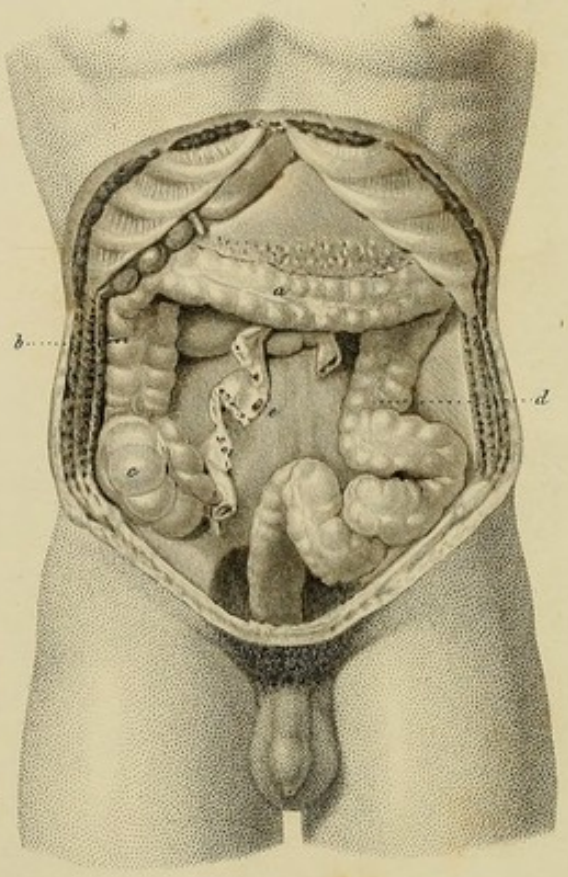


Fig. 2.

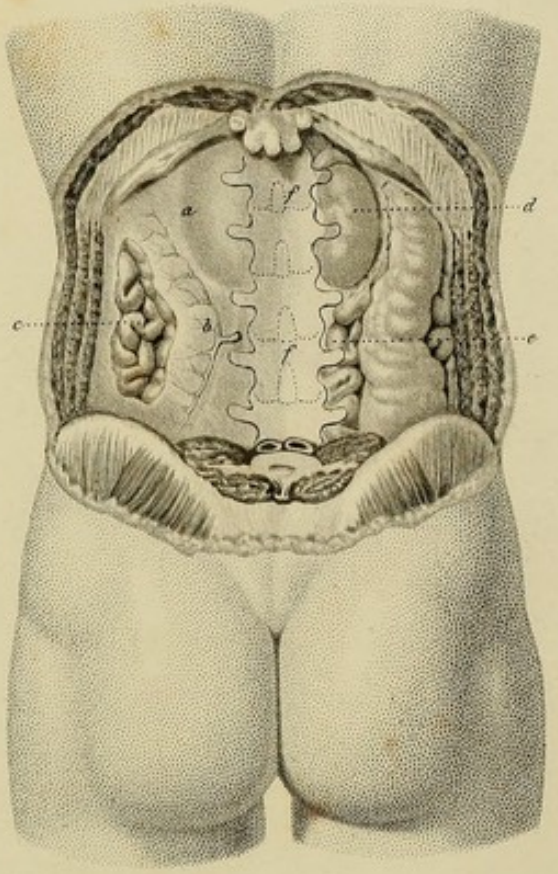


Plate LXVIII.

OPERATION FOR ARTIFICIAL ANUS.

SURGICAL ANATOMY.

Fig. 1. The anterior wall of the abdomen and the mass of the small intestines have been removed; the large intestines have been retained so as to show their arrangement. *a*, the transverse portion, or arch of the colon; *b*, the ascending colon; *c*, the cœcum; *d*, the descending colon.

Fig. 2. *Posterior aspect of the trunk.*—The posterior wall of the abdomen has been removed. *f f*, the dotted lines, show the position of the vertebræ; *a*, the left kidney, covered with an aponeurotic layer; *b*, arteries winding along the lumbar region. A portion of the peritoneum being removed, the small intestines, *c*, are brought into view; *d*, the right kidney; *e*, the right or ascending colon.

This figure shows the general arrangement of the viscera in the lumbar region.

Plate LXIX.

OPERATION FOR ARTIFICIAL ANUS.

MODES OF OPERATING.

Fig. 1. *Operation for artificial anus performed in the cœcum*, by the method of Littre.

a a, a dotted line showing the course of the ascending colon and the cœcum; *b b*, an incision in the right iliac fossa carried through the walls of the abdomen; *c c*, blunt hooks holding the lips of the wound apart, at the bottom of which the cœcum *d* is seen.

Fig. 2. *Callisen's method.—Amussat's method.—a a*, dotted line, showing the course of the descending colon; *b b*, a transverse incision of the sub-cutaneous layers; *c c*, blunt hooks holding the lips of the wound apart; *d d*, loops of thread passed through the portion of the descending colon, which has no peritoneal investment.

Fig. 3 and 4. *Union of the lips of the intestinal wound to the edges of the wound in the abdomen, by points of suture.*

ARTIFICIAL ANUS—MODES OF OPERATING.

We have already treated of *abnormal anus*, which is liable to result from certain varieties of hernia, and also of the various methods which have been employed for its cure.

The *creation of an artificial anus*, constitutes a regular operation, by which the surgeon proposes to make an orifice in the intestine, and in the corresponding portion of the abdominal wall, through which the feces can escape, when, as in certain pathological conditions, their passage by the natural anus is prevented.

According to Amussat, the following conditions may require the performance of the operation:

1st. Accumulation of feces in consequence of an obstruction of the rectum, or any other portion of the large intestine, when the obstacle

Pl. 69.

Fig. 1.

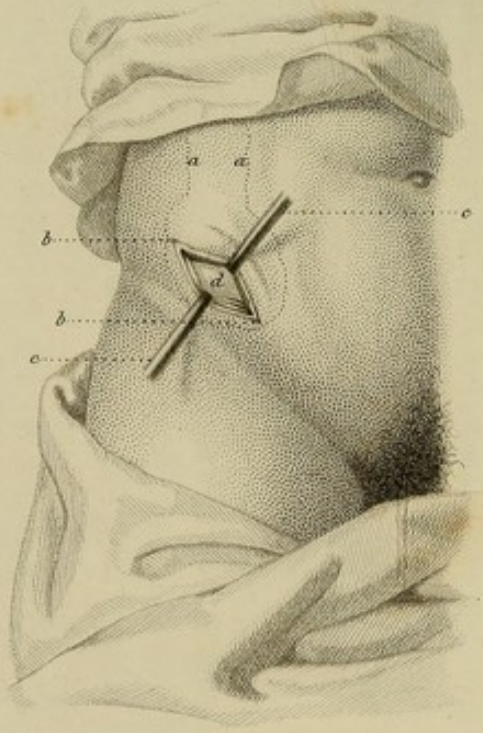


Fig. 3.

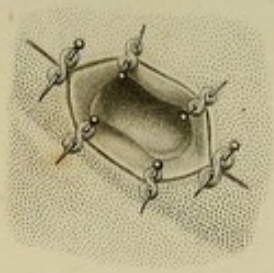


Fig. 4

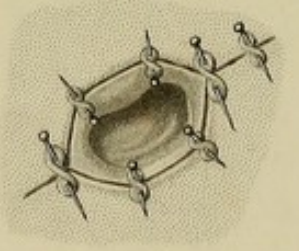
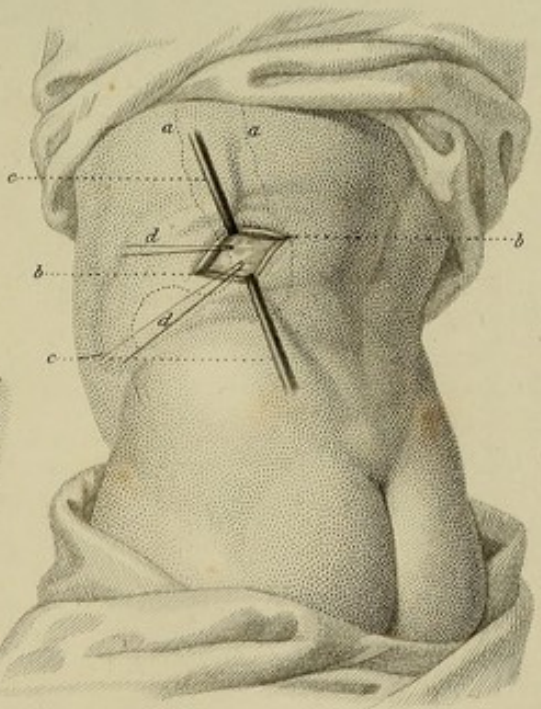


Fig. 2



cannot be removed through the natural passage below, and life is thereby in danger.

2d. For cancerous diseases of the rectum and large intestine, when they occasion difficulty in defecation.

3d. When the rectum is congenitally imperforate, or rather when a portion of this intestine is wanting, and the passage cannot be established from below.

There are but two methods now adopted by surgeons.

The first is Littre's (1710), who, having seen an obliteration of the rectum in a child who died on the sixth day, pointed out the possibility of making an artificial anus through the abdominal parietes and the sigmoid flexure of the colon. The second method was proposed by Callisen of Copenhagen, and consists in making an opening in the descending colon in the lumbar region.

Littre's method.—Plate 69.—The instrumental apparatus consists of straight and convex bistouries, scissors, ligature forceps, waxed threads and suture needles.

The patient being laid upon his back, an incision from two to three inches in length is made in the right iliac region, commencing on a line with the anterior superior spinous process of the ilium, and carried forward in a direction parallel with Poupart's ligament. The different layers which constitute the abdominal parietes at this point, are successively and cautiously divided upon the director. The peritoneum being opened, the sigmoid flexure of the colon presents itself, and is recognised by the sacculi and transverse bands which are the anatomical characteristics of the large intestine; a ligature having been passed through the intestine to keep it in apposition with the opening in the abdominal wall, a longitudinal incision is then made in it which gives exit to the fecal matter. Injections should also be employed, both above and below the opening. Adhesions soon form, which unite the intestine to the peritoneum and the anterior wound, when the ligature which had been passed through it should be withdrawn, and the surgeon, by proper care, can generally prevent the new anus from becoming contracted.

The lips of the wound in the intestine may then be united to the edges of the wound in the abdomen by points of suture. (See figures 3 and 4.)

Callisen's method (fig. 2).—To avoid wounding the peritoneum as in Littre's method, Callisen proposed to open the descending colon in

the lumbar region, between the last false rib and the crest of the ilium. The descending colon can be approached in this part of its course without wounding the peritoneum, and upon this fact Callisen's method is based. Callisen's operation was, however, rejected by the great majority of surgeons. In 1839, Amussat directed attention to its feasibility, and proposed the following mode of performing the operation :

Amussat's method.—Surgical anatomy.—It is important that the relations of the peritoneum with the colon, in the lumbar region, should be well understood. If the posterior aspect of this intestine is examined, after removing the mass of muscle which covers it, it will be found that the whole of its posterior third is uncovered by the peritoneum. This posterior portion of the intestine, therefore, lies in contact with the abdominal parietes without the intervention of the peritoneum, and can be opened without wounding that membrane. But this extra peritoneal portion of the colon is not always of the same length; in some cases, the peritoneum passes in front of the colon, covering only its anterior aspect; in others, it envelopes it more or less completely, the cul-de-sac, which it forms when folded upon itself, being almost in contact behind the gut. The descending colon can only be opened between the kidney and the crest of the ilium. Its course is usually the same as that of the tendinous depression which separates the quadratus lumborum from the transversalis muscle, a depression which is indicated by the external border of the common mass of the sacro-lumbalis and longissimus dorsi. Sometimes its course is a little more inwards, and it is found anterior to the quadratus lumborum.

The color of the descending colon is more or less green. It is well to note this fact, as, in certain cases, it may aid in distinguishing it from the small intestines, which are of a yellowish hue.

To extend that portion of the colon which lies without the peritoneum, its volume may be increased, either by filling it with air or by injecting it with liquid.

Method of operating.—The patient is laid upon the belly, with a little inclination to the right, and two cushions tied together are placed under his abdomen. The surgeon then makes a transverse incision of the skin about two fingers' breadth above the crest of the ilium, commencing at the external border of the common mass of the sacro-lumbalis and the longissimus dorsi muscles, and continuing it

outwards for about four or five fingers' breadth. Beneath the skin and sub-cutaneous layer, the latissimus dorsi is met with, which is divided across at the posterior third of the incision, while the two anterior thirds divide the external oblique. Beneath these lie the internal oblique, the transversalis and the aponeurosis. This last deep layer should be divided vertically, that the intestine may be more readily recognized. If the patient be fat, the skin and sub-cutaneous layers may be divided by a crucial incision.

Beneath all these layers lies the colon, masked by cellular and adipose tissues, which should be very cautiously removed. The most delicate part of the operation is to make out and open the intestine. Before opening it, it should be thoroughly exposed on both sides, without pressing upon it. In the subject, the intestine is recognised by its greenish color, a sign which sometimes holds good in the living being; this color is owing to the presence of fecal matters. The surgeon can assure himself by pressure and percussion that it is an intestine. The colon offers considerable resistance to pressure, and the want of resistance to the outer side is a very important sign, as indicating rather the presence of small intestine. If the intestine is contracted, it must be looked for further back; it may even be entirely concealed beneath the quadratus lumborum, which must then be divided across, if it has not been done already. There should never be any hurry to open the intestine; on the contrary, it is better to allow it time to distend itself, and project into the external wound.

The intestine being satisfactorily recognised, the surgeon, by means of needles, carries two loops of thread through its walls, at a distance from each other of about two-thirds of an inch; giving these to an assistant, he makes a puncture between them with a trochar, when the escape of gas and some fluid matters proves that the cavity of the intestine has been penetrated. This little opening made by the trochar is then enlarged by a crucial incision with a probe-pointed bistoury, which is carried down along the side of the canula. The opening, thus enlarged, gives exit to a large quantity of gas and semi-fluid matter. After the first jet of this matter, its expulsion is aided by one or two injections of warm water into the intestine, above and below the wound. When free exit has been given to the feces, and there is no longer any danger of a large or sudden expulsion of fecal matter, the opening in the intestine should be drawn outwards by forceps, and fastened to the skin by four points of interrupted suture.

The mucous membrane should be everted when these points of suture are inserted. The size of the wound can be diminished by bringing together the integuments at its posterior angle, by a point of interrupted suture (figures 3 and 4).

Malgaigne, after performing this operation in two cases, found that it was unnecessary to make a crucial incision of the muscular layers, as they retract sufficiently to expose the bottom of the wound fully.

Summing up.—Callisen's method is superior to Littre's, as by avoiding the peritoneum, the probabilities of success are increased. An artificial anus situated behind is preferable to one in front, and will, in most cases, prove less inconvenient.

Fig. 1.

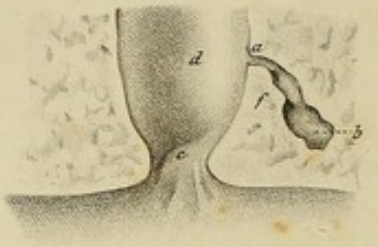


Fig. 3

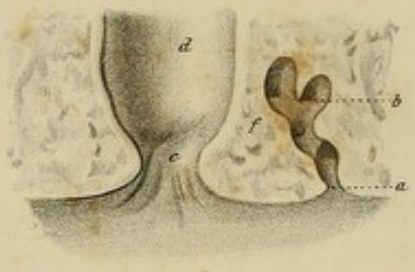


Fig. 2.

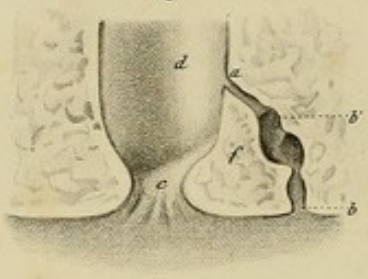


Fig. 4

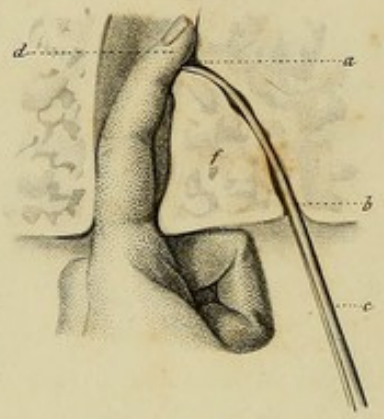


Fig. 5

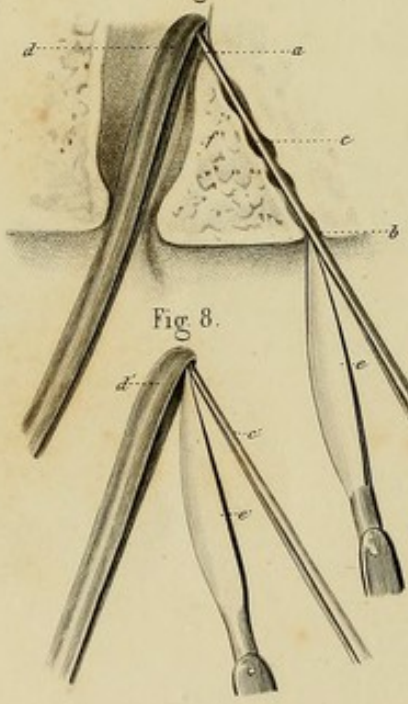


Fig. 6.

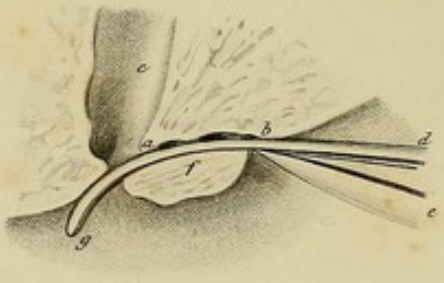


Fig 8.

Fig. 7

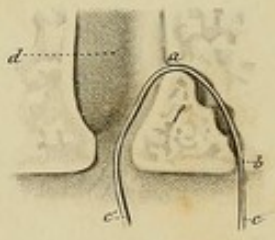


Plate LXX.

OPERATIONS UPON THE ANUS AND RECTUM.

All the figures of this plate represent a vertical section of the rectum, anus, and of a fistula in ano.

Fig. 1. *Fistula with an internal orifice only.*—*a b*, the fistula; *a*, the internal orifice opening into the intestine *d*; *b*, the fistulous cul-de-sac; *c*, the anus; *f*, section of the tissues lying between the fistula and the intestine.

Fig. 2. *Simple fistula.*—*a b b*, course of the fistulous passage opening at *a* into the intestine *d*, and externally at *b* in the vicinity of the anus *c*; *f*, section of the tissues lying between the fistula and the intestine.

Fig. 3. *Fistula with an external orifice only.*—*a*, the external orifice of the fistula; *b*, the cul-de-sac and sinus; *d*, the intestine; *c*, the anus.

Fig. 4 and 6. *Incision.*—*Usual method* (fig. 4).—*First step of the operation.*—An annealed silver director *c* is carried through the fistulous passage *a b*; *d*, the index finger of the surgeon in the intestine receives the point of the director as it passes through the internal orifice of the fistula, and bending it down, brings it out at the anus.

Fig. 6. *Second step of the operation.*—*Incision.*—The point of the director *g* has been brought out externally; *a b*, the fistulous passage; *e*, the blade of the bistoury inserted into the groove of the director *g d*; *f*, the tissues about to be divided with the bistoury.

Fig. 5 and 8. *Desault's method.*—A director *a c b*, carried through the fistulous passage, is caught in the groove of another very large director *d*, which has been introduced into the intestine. The bistoury *e* is inserted into the groove of the director, in order to divide the intervening tissue *f*.

Fig. 8. *The same operation.*—The bistoury *e* is caught in the groove of the large director *d*. These two instruments being withdrawn together, effect a complete section of all the soft parts lying between the angle which they form. *c*, the director.

FIG. 7. *Ligature.*—The silk thread introduced into the fistula *b a*, enters the intestine *d*, and being brought out at the anus, embraces in the loop *c a e*, the whole of the soft parts (*f*) lying between the fistula and intestine.

FISTULA IN ANO—MODES OF OPERATING.

There are several kinds of fistulas of the anus; one variety, the *complete* (fig. 2), consists of a sinus opening into the intestine by an *internal orifice*, and in the vicinity of the anus by an *external* orifice. Another variety, the *incomplete*, has a single orifice only, and terminates internally by a cul-de-sac. The orifice of the *external incomplete* fistula is found in the vicinity of the anus, and its sinus does not communicate with the intestine. The *internal incomplete* fistula opens into the intestine, and has no external communication. Fistulas are called *complicated* when they consist of several passages, are sinuous, and burrow in the soft parts; also when they are accompanied by thickening, induration, &c. These different complications require some modifications in the modes of operating.

To find out the nature and extent of the fistula, the surgeon must explore it by means of a very small and flexible probe, introduced by one of its orifices, and frequently several attempts are required before a satisfactory conclusion is arrived at. It is always easy to find the *external orifice* which, in the great majority of cases, lies to one or the other side of the anus, and rarely in front or behind it. The opening is not always single, the external surface of the fistulous opening being occasionally pierced by numerous small orifices like the spout of a watering pot. The skin may be detached over the whole extent of surface occupied by these little orifices, which most frequently converge to a single passage which opens into the intestine. The internal orifice is more difficult to recognise. In the great majority of cases it will be found opening just above the external sphincter, and very near the anus. Examination with the finger will assist in its discovery. For this purpose, the surgeon after well oiling or greasing his index finger, introduces it into the rectum, where it may meet with a thickening, or depression, or produce very acute pain. Towards this point, the probe should be first directed, when, if it passes into the rectum and comes in contact with the finger, there can be no more doubt concerning the existence of the internal orifice.

Figure 4 represents this process of exploration. The finger of the surgeon, *d*, is introduced into the rectum; a director, *c*, entered by the external orifice, *b*, is carried through the fistulous passage, and at the internal opening, *a*, comes in contact with the point of the finger, *d*.

When the surgeon, by means of the finger and probe, cannot discover the internal opening of the fistula, he may inject milk or some other colored fluid into the external orifice; if the fluid escapes by the anus, the existence of a communication is evident;—or a very large injection may be administered to the patient; its almost immediate expulsion forces a portion of the fluid into the fistulous passage, which proves the existence of an internal orifice. Fistulæ may be cured by *cauterisation*, *ligature*, or *incision*.

Cauterisation.—The object of cauterisation is to create an inflammation of the walls of the sinuses and facilitate their adhesion to each other.

It was employed by Hippocrates, but, being found to be unreliable, is rarely adopted at the present day. It is only applicable to simple, and very short fistulas.

Some surgeons use the actual cautery. Others employ various kinds of caustics, which are introduced into the fistulous passage by means of lint tents or by injections. But these processes are tedious and painful, and frequently produce dangerous inflammation. Therefore some one of the various modes of operating which we are about to describe is usually preferred.

Ligature (fig. 7).—Linen or silk cord, or silver wire, may be used. A flexible, silver-eyed probe is used to introduce the cord; the ligature is passed through the eye of the probe, which is then carried through the fistulous passage into the rectum, when it is bent down and brought out by the anus. The soft parts lying between the fistula and the rectum are thus included in the loop *b a e'*, and the section is effected by uniting and tightening the two extremities of the ligature by means of a knot-tyer.

When a wire ligature is used, a small canula is first introduced into the fistulous passage; the wire is passed through this canula into the rectum, and is brought out by the anus; the canula is then withdrawn and constriction produced by twisting the wire. When the fistula is small, the ligature may be tied without using the knot-tyer. The time required for a complete section of the soft parts varies from

two to six weeks. The ligature requires frequent tightening, which always causes severe pain, and it is frequently necessary to terminate the operation by using the knife. Therefore, preference is generally given to incision.

Incision.—A purgative should be administered the night before the operation, and an injection in the morning, so that there may be no urgent necessity for the patient to go to stool for several consecutive days.

The instruments required are the ordinary straight bistouries, and Pott's concave bistoury; a very flexible, annealed silver director, which will readily follow the course of the fistulous passage, and can be easily bent down and brought out as afore-mentioned; a steel director, rather pointed, and with a continuous groove, may be useful to perforate the intestine, and convert an incomplete or complicated fistula into a simple one, and thus render the insertion of the silver director more easy; a large boxwood or ebony director to introduce into the rectum, when the internal orifice is high up, and the silver director cannot be bent down and brought out at the anus (figures 5 and 8). The dressing consists of lint, compresses and a T bandage.

The patient should be placed on the edge of the bed on the same side as the fistula, a pillow beneath the hips, and the upper thigh flexed and drawn aside by an assistant, who at the same time holds up the buttock. The thigh below must be straightened and held firmly in this position by another assistant. A third assistant depresses the other buttock and takes charge of the instrument.

Ordinary method (fig. 4 and 6).—This operation is particularly applicable to complete sub-cutaneous fistulæ, and to those whose internal orifice is very near the anus. The fistulous passage being satisfactorily made out, the surgeon introduces his index finger into the rectum, and inserts a probe through the fistula until it reaches his finger in the intestine; this probe he hands to an assistant, and using it as a guide passes the silver director along it also into the intestine, which being effected, he withdraws the probe. With the index finger *d* (fig. 4), he bends down the point of the director *a*, and at the same time using it as a lever, he succeeds in bringing it out at the anus (fig. 6); in this way, the director is carried completely around all the parts intervening between the intestine and the fistula. The surgeon then taking the handle of the director in one hand, with the other

inserts the point of bistoury into its groove, and divides the mass of tissues resting upon it, *f*, at one stroke.

The name of *syringotome* has been given to various bistouries terminated by flexible probes.

Desault's method (fig. 5 and 8).—When the internal orifice of the fistula is too far up to allow the surgeon to bring out the point of the director, as in the ordinary method, some modification in the instruments and mode of operating is required. Instead of the index finger, the surgeon uses a very large director, generally made of hard wood, with a broad, deep groove, which does not extend to the extreme end of the instrument. The surgeon having carried the silver director through the fistulous passage, then introduces the large director into the rectum, and catches the point of the silver director in the termination of its groove. Figure 5 shows these two instruments in contact; the large director *d*, receives the point of the small director *a*. The surgeon having satisfied himself that these two instruments are in their proper relative positions, confides the large director to an assistant, who holds it firmly in place; the surgeon holding the smaller director, inserts the point of the bistoury into its groove, and carries it with a sawing motion up to the large director, which he then takes in his hand, and divides with the knife all the soft parts *f*, lying between it and the fistula. The two directors, still in contact, are then brought out together, showing that the division has been complete. When there is no internal orifice, or when it is very difficult to find, the surgeon can substitute the steel director, with the groove running to its extremity, in the place of the silver director; by pressing the point of this instrument upon the large director, it easily passes through the walls of the intestine, and the remainder of the operation is then performed as described above. When the fistula is uncomplicated, a simple incision is all that is required. But when the skin is undermined to a greater or less extent, it must be slit up and excised, so as to leave a wound with a flat surface (Malgaigne). When there are several isolated fistulas, they should be divided one after the other, but if it be possible, they ought to be united in a single incision.

When there is a number of sinuses of small size, it is better to excise them altogether by means of a pair of scissors curved on their flat surfaces.

After the operation, a large tent covered with cerate should be

introduced into the rectum, a portion of which tent must be forced into the incision, to keep its lips apart, in order that cicatrisation may first commence at the bottom of the wound and gradually work its way outward. A few layers of lint and a T bandage complete the dressing.

FISSURE OF THE ANUS.

The name of *fissure of the anus* has been given to a small elongated ulcer situated in the deepest part of the folds around the margin of the anus. If the fissure be slight and superficial, affecting the mucous membrane alone, astringent applications, caustics, &c., may be used successfully. But when the fissure is accompanied by a *painful constriction of the sphincter*, this treatment will prove to be ineffectual, and recourse must be had to some one of the modes of operating which we are about to describe.

Cauterisation.—After dilating the anus, the entire surface of the fissure must be touched with the nitrate of silver. This application produces a great deal of pain, and will be required more than once before a cure is effected.

Compression and dilatation.—Compression is produced by means of tents introduced into the rectum; these tents, regularly increased in size, serve to dilate the sphincter. A great deal of pain is always produced upon their first introduction. The pain, however, diminishes after each tent is introduced. Vidal (de Cassis) has found that tents, smeared with a mixture of mercurial ointment and the extract of belladonna, answered a good purpose. It has been advised to commence the treatment by introducing large tents at once, so as to produce an immediate dilatation of the sphincter, and to put the fissure upon the stretch as much as possible. The first tent should be allowed to remain for a day or two. After its withdrawal, an emollient injection should be administered to the patient, so as to produce a free evacuation of the bowels, before other tents are introduced. Cauterisation may also be found useful during the continuance of this treatment.

Recamier's method.—In 1838, Recamier demonstrated the possibility of curing fissures of the anus by *extension* and *dilatation*.

The patient is laid on one side upon the edge of the bed, his limbs are separated from each other, and the legs flexed upon the thighs. The surgeon having well oiled his right index and middle fingers,

introduces them carefully and one after the other into the anus, and carries them up as far as the last phalanx. He presses firmly with them upon the coccyx and both sides of the rectum. The pain is acute, but subsides so soon, that Recamier does not consider it necessary to put the patient to sleep. To dilate the sphincter to a greater extent, Recamier sometimes introduces the index finger of the left hand, in addition to the fingers already in the rectum. This mode of dilatation is not dangerous.

Excision.—Velpeau seizes the middle of the fissure with a hook, raises it up, and excises it with a single cut, either with the bistoury or a pair of scissors curved on their flat surface. A large tent is then introduced into the rectum, to keep the anus dilated while cicatrisation is taking place. This method, which is only applicable to superficial fissures, has failed in two operations out of six performed by Velpeau.

Incision of the sphincter ani.—Boyer's method.—This operation is particularly applicable to fissures produced by spasmodic constriction of the sphincter muscle. Emollient injections, or light purgatives, should be administered before the operation, so that the patient can abstain from going to stool for several days. The patient lies upon his side upon the edge of the bed, with his thighs flexed upon the body; the surgeon, having the index finger of his left hand well oiled, introduces it into the rectum, and laying the blade of a very narrow probe-pointed bistoury flatwise upon it, carries this also into the intestine. The edge of the knife is then turned towards the same side as the fissure, and with a single cut the surgeon divides the intestine, sphincter, cellular tissue, and the integuments. The result is a triangular wound, whose apex is in the intestine, while its base is formed by the skin. If it be necessary to enlarge the wound, it can be done with a single cut of the knife. Sometimes the intestine yields to the knife, and the wound of the cellular tissue extends farther up than that of the rectum; in which case, the incision in the latter must be extended. When the constriction was excessive, Boyer made two similar incisions, one on the right, and the other on the left side; if the fissure was situated either in front or behind, it was not included in the incision.

A large tent is then introduced into the wound or wounds, which prevents them from healing irregularly. A moderate sized lint tent is also introduced into the rectum, several long compresses are

applied, and the whole is kept in place by a T bandage. This first dressing is allowed to remain for two or three days, after which the wound is dressed with a compress spread with cerate, until it is entirely healed, which result is usually obtained in the course of a month or six weeks.

Superficial incision of the mucous membrane.—Sedillot's method.—It frequently happens that a slight excoriation of the mucous membrane is the primitive cause of the constriction of the sphincter. A small shallow ulceration, concealed in one of the folds of the anus, may constitute the fissure whose cicatrisation cannot be effected in consequence of the laceration which takes place at every effort of defecation. It is a wound whose cicatrix is being continually ruptured, and which becomes irritable and painful. In such cases, Sedillot divides the mucous membrane through the whole extent of the fissure, without injuring the sphincter. The edges of the little wound are kept apart, and the ulcer afterwards heals of itself, or under the influence of slight cauterisations.

Sub-cutaneous section.—Blandin's method.—In performing this operation, Blandin used a narrow sharp-pointed bistoury, whose blade was masked by another blunt-pointed blade, which could be drawn back into the handle. A tenotomy knife, or a probe-pointed bistoury, can be used instead of Blandin's instrument. A puncture half an inch or an inch from the anus is made, by which the tenotomy knife laid flat is introduced beneath the skin; the index finger of the left hand is introduced into the rectum, to serve as a guide to the instrument, the edge of which is then turned towards the muscle, so as to divide it from within outwards. A cracking sound announces the section of the muscle, and the finger in the rectum can feel the furrow produced by the separation of its divided fibres.

This operation is tedious and difficult; Blandin himself was frequently obliged to perform a second operation upon patients who were not cured by the first. So Boyer's method by incision, or Recamier's by dilatation, are generally preferred.*

* The experience of English and American surgeons has proved that the simple incision of the mucous membrane upon which the ulcer is seated, suffices to cure the great majority of anal fissures.—Am. Ed.

Pl. 71

Fig. 1.

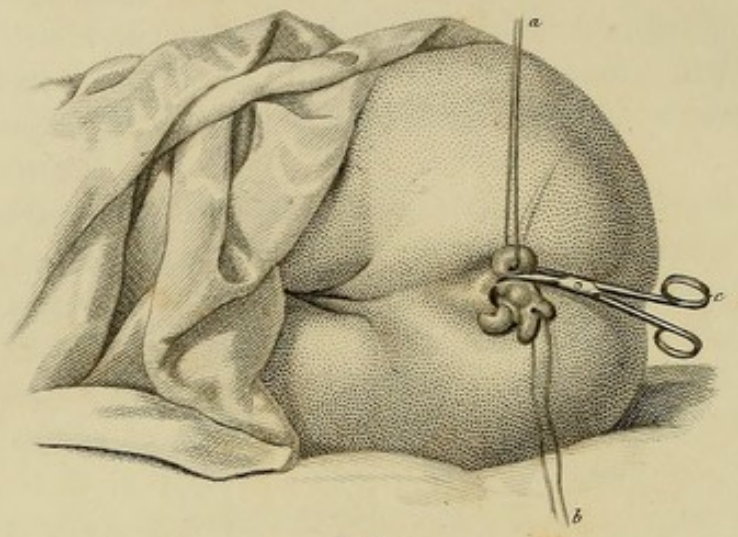


Fig. 2

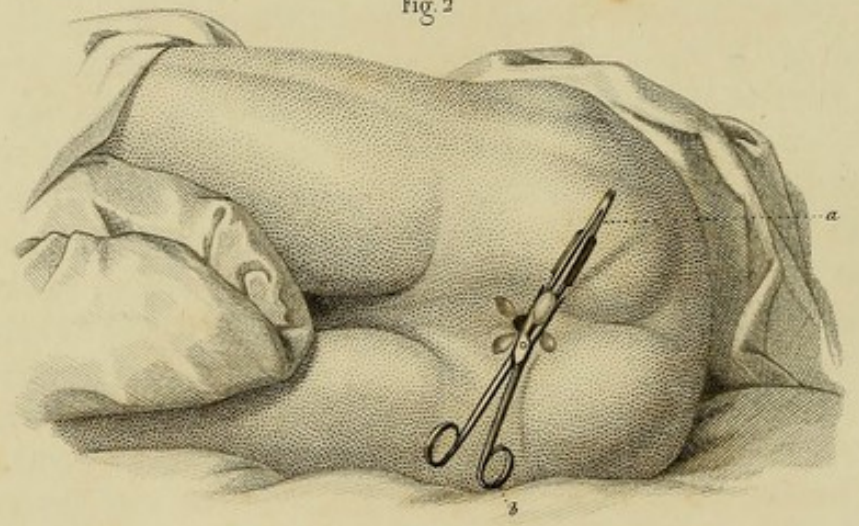


Fig 3.

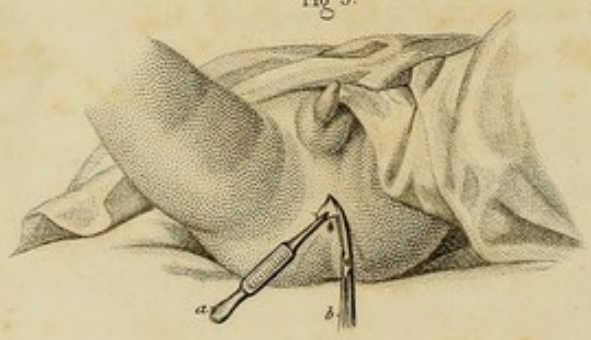


Plate LXXI.

CONTINUATION OF OPERATIONS UPON THE ANUS AND RECTUM.

Fig. 1. *Excision of hemorrhoidal tumours.*—The tumours are firmly held by the loops of thread *a* and *b*, which have been carried through their bases; excision is being performed with the curved scissors *c*.

Fig. 2. *Excision of the folds radiating from the anus.*—A fold caught with the forceps *a*, is being excised with the scissors *b*.

Fig. 3. *Imperforate anus.*—Excision of the small flaps, each flap caught with the forceps *a*, is being excised with the scissors *b*.

HEMORRHOIDAL TUMOURS.

The operation for hemorrhoids is required when the tumours from their size prove an obstacle to defecation, when they are inflamed, painful, or when the loss of blood to which they give rise tends materially to weaken the patient; for internal hemorrhoids which drag down the rectum, and cannot be reduced, and for such as exhibit a tendency to degenerate.

Incision, *cauterisation*, *ligature*, and *excision*, are the principal modes of operating which are adopted at the present day.

Incision is only applicable to small tumours. It produces a discharge of blood which may facilitate the reduction of internal hemorrhoids, and always gives temporary relief. This operation may be performed either with the bistoury or the lancet, but the disease returns in a short time. Incision cannot, therefore, be considered as a means of cure.

Cauterisation is now only employed to arrest the hemorrhage which may result from excision. In fact, caustics are not suited to all cases, and it is frequently impossible to limit their action. On account of the dangerous results which sometimes follow their use, Amussat has invented a pair of very ingenious forceps, which are intended to limit their action (see instruments, plate XVII., fig. 8). A tube is inserted into the end of each branch of the forceps, which

can be filled with Vienna paste. A longitudinal slit, which can be opened or closed at will, allows the caustic to be brought in contact with the parts grasped between the tubes. The hemorrhoidal tumours are compressed between these tubes by means of a screw attached to the branches of the forceps. This invention of Amussat's is deserving of the attention of surgeons, and may be of service in bringing cauterisation again into notice as a means of treatment.

Begin's method.—This method consists in bringing down the internal hemorrhoids by means of a plug of lint which is introduced into the rectum, and then pulled upon, so as to draw the tumours out of the anus. The actual cautery is then applied, and when the eschar seems sufficient, the plug is withdrawn.

Ligature.—This method is particularly applicable to pedunculated tumours. But when the tumours are large at the base, or consist of a cluster of excrescences, several ligatures of silk should be passed through them, each of which must be tied separately.

The operation by ligature is not always harmless; it has frequently been followed by dangerous symptoms, and is not always satisfactory in its results. It is now rarely performed.

Excision.—The excision of external hemorrhoids is neither a dangerous nor difficult operation. If hemorrhage arises, it can be arrested by compression or cauterisation. More difficulties are presented by the excision of internal hemorrhoids. The patient should be put upon a moderate diet for some days before the operation; a laxative injection should be given, for the purpose of emptying the intestine, and forcing out the tumours. (Plate 71, fig. 1.)

Boyer's method (fig. 1).—When the tumours project sufficiently, the patient should lie down upon the edge of the bed. If the tumours are distinct and separate, a double ligature may be passed through each of them, or they may be caught with hooks; but if, as is usually the case, they form a large mass divided into several portions by furrows which are more or less deep, a loop of thread must be passed through each portion. If all of them are not made fast, the pain caused by the first incision will produce a contraction of the anus, the tumours may return, and their excision be thus rendered difficult, and perhaps impossible. Everything being arranged as above described, the surgeon seizes both ends of the thread passed through the tumour, or that portion of the mass upon which he proposes to operate first, and gives the remainder of the threads into the hands of an assistant.

He then pulls moderately upon the ends of the thread to cause the tumour to project still farther, and he cuts it off at its base with the bistoury, taking care, however, to turn the back of the instrument towards the anus. He then excises in the same way, one after the other, all the remaining tumours, or portions of the mass through which a loop of thread has been passed. Most authors advise that the membrane which covers the tumours be first incised, and as much of it detached from them as possible. This precaution was considered necessary, especially when there were a number of tumours to extirpate, to prevent too great a loss of substance of the walls of the anus and its consequent contraction. But the mucous membrane which invests the hemorrhoidal tumours is so closely connected with their substance, that it is almost impossible to dissect it off, and this dissection is rendered still more difficult by the quantity of blood which escapes, and masks the parts, as soon as the first incision is made. The contraction of the anus and lower part of the rectum is prevented by the use of tents, or by incising the anus and its sphincter after the tumours are extirpated. This incision is also beneficial in facilitating the introduction of plugs and tents, which a spasmodic contraction of the sphincter renders very difficult.

Before dressing the parts, the patient should strain, as if attempting to have a stool, to expel the blood which may have been effused into the rectum; a plug, covered with cerate, should then be inserted, and pushed up as far as possible. Several little tents tied together are then introduced, and a roll of lint on the outside to which these tents are fastened, completes the dressing. The whole is kept in position by means of a T bandage. Boyer applied this dressing when he feared a subsequent hemorrhage.

Velpeau's method.—To avoid the danger of hemorrhage, inflammation, and purulent infection, Velpeau heals the wound made by the removal of the hemorrhoids, by the first intention. For this purpose, he fastens each tumour which he proposes to remove externally, by means of a hook, and passes the necessary number of threads through its base. He then cuts off the tissues in front of these threads, either with the bistoury or scissors, and ties each thread separately. Velpeau considers tents and plugs to be unnecessary. He has seen complete cures in ten or fifteen days.

Dupuytren inserted a small tent of lint; if hemorrhage arose, he applied the actual cautery.

Marx advises the application of the actual cautery immediately after the operation, to prevent all danger of hemorrhage.*

VENEREAL EXCRESCENCES.

Excision is the most simple and rapid method. Each tumour is seized with the forceps, and excised with the scissors. The hemorrhage is readily arrested by touching the wound with the nitrate of silver, and then applying a little scraped lint.

POLYPI OF THE RECTUM.

Ligature and excision are the only methods in use at the present day. If the polypus be external, there is nothing peculiar in the operation; if it be internal, it must be drawn out in the same way as in operating upon internal hemorrhoids.

CANCER OF THE RECTUM.

Surgical anatomy.—The following anatomical details are borrowed from Lisfranc.

1st. In the adult female, the antero-posterior diameter of the perineum is about fourteen lines; it never varies more than three or four lines from this measurement.

2d. In both sexes, the distance from the anus to the inferior portion of the coccyx, is twenty-two lines; the distance from the anus to the base of the coccyx is twenty-seven lines.

3d. In women, by making an oval incision about ten lines from the anus, and carrying up the dissection until it reaches the intestine, upon which slight traction is made, it will be found that about twenty-seven lines of the lateral and posterior portions of the rectum can be removed without injuring the vagina; on account of the internal

* The opinion expressed in the text as to the danger attending the ligature of internal piles, and also the prominence, and apparent preference, given to the operation of excision, are neither in accordance with the results obtained by the best surgeons of the present day. Ligature is by far the safest and most effectual remedy for internal hemorrhoids, and the great danger of hemorrhage after *excision*, has caused this operation to be justly abandoned. In this city the experience of Mott, Cheeseman, and our best practical surgeons, is entirely in favor of the ligature.—Ed.

adhesions which it has with the vagina, only about eighteen lines of the rectum can be removed in front. These adhesions, formed by muscular fibres, and by a tendinous and a very dense compact cellular tissue, take their origin from the sub-cutaneous adipose tissue, at about three lines within the skin. The rectum can be separated from the vagina with the finger, as far as the peritoneum.

4th. In both sexes, traction upon the rectum, proved by the straightening of its curves, will not cause the peritoneum to descend more than a line; this can be proved by performing the operation upon the subject with the abdomen laid open.

5th. In man, after making the incisions around the rectum, and carrying up the dissection as far as the intestine, upon which moderate traction is made, about twenty-two lines of its entire circumference can be removed without danger of wounding the urethra.

6th. In front of the prostate gland, the urethra is in relation with the rectum for about three lines and a half, being united to it as well as to the bladder by a fine elastic cellular tissue; when the urethra enters the perineum, the distance between it and the rectum increases as it advances in front, and from the point where it leaves the intestine to the skin, it forms an angle of about twenty degrees with the axis of the intestinal canal. The tissues which lie between this angle are too well known to require description here; it is only necessary to mention, that separation with the finger is impossible until they have been divided with the knife.

7th. The superficial branch of the internal pudic, the transversus perinei, the inferior, middle and some small branches of the superior hemorrhoidal arteries, are the only important vessels which are in danger of being wounded; it is by no means impossible to tie or compress them; there is no danger of hemorrhage, in performing the operation described below.

MODES OF OPERATING.

Dilatation.—Dilatation is only a palliative proceeding, which may be resorted to in cases where excision is not practicable. (*See contraction of the rectum*)

Excision.—Lisfranc's method.—The patient should be laid on his side, upon a bed or table covered with a mattress, his thighs half flexed, and held in this position by assistants. One of these assistants

puts the integuments around the anus upon the stretch, while another hands the instruments to the surgeon, who drawing upon the integuments with his left hand, with a convex bistoury held in the first position in his right hand, makes two semi-lunar incisions through the skin, which meet before and behind the rectum. If there are vegetations or carcinomatous ulcerations of the skin around the anus, these may be removed by making the incisions farther from the rectum. The skin is then dissected up by turning the edge of the knife towards the rectum, which is thus isolated on every side. By making these two incisions, the surgeon, introducing his finger into the rectum, can draw it out more than an inch. When the cancer is superficial, including only the mucous membrane, or the coats of the intestine, and when at the same time it does not extend but a trifle more than an inch above the anus, by bending the index finger, already introduced into the intestine, and pulling it downward, the rectum can easily be everted and the whole of the disease exposed. This everted intestine is then slit up and removed by means of a pair of strong scissors curved on their flat surface. When the disease presents itself in this simple form, the operation is easily performed. Some of the fibres of the external sphincter are usually left uninjured, and after the wound is healed, patients rarely experience any inconvenience in defecation.

When the disease includes the whole of the intestine and the surrounding cellular tissue, and extends upwards more than two inches and a quarter, a more complicated operation than the one just described will be required. After making the two semi-lunar incisions and dissecting up the whole of the inferior portion of the rectum, the surgeon must introduce his index finger into the intestine, and using it as a guide for a pair of strong straight scissors, he divides the rectum in a direction parallel to its axis. This incision should be made at the posterior part of the rectum, because there are fewer blood vessels in this situation, and there is less danger of wounding the peritoneum, or any other important organ. The incision must be carried beyond the limits of the disease, which are easily seen, as the intestine can be spread out and examined. As some small arterial branches are necessarily divided, the operation should be occasionally suspended for two or three minutes, and a sponge dipped in very cold water inserted into the wound, to arrest the hemorrhage. When the sponge is withdrawn a fair opportunity is given to exa-

mine the nature and extent of the disease. Very little blood is lost. Two or three hooks inserted into the intestine enable the surgeon to draw it down and keep it in this position. When the patient is a female, and the disease includes the whole of the intestine, an assistant should insert two of his fingers into the vagina, to put the recto-vaginal septum upon the stretch. The greatest care is required in making the dissection at this point.

When the patient is a male, a catheter should be introduced into the urethra, which will serve as a guide, while the surgeon dissects up the anterior portion of the rectum. This catheter should be held by an assistant, who will give the operator notice when the knife comes too near the urethra; the surgeon should also take hold of it from time to time, and moving it up and down, satisfy himself of the exact position of the urethra, and the thickness of the soft parts which cover it.

After the operation, the surgeon must introduce his finger into the wound, to discover if anything remaining requires removal. After which a tent of suitable length and size is to be inserted.

In women, it is advisable to draw off the water with the catheter for some two weeks after the operation, to prevent the wound from being irritated by the contact of the urine.

Velpeau's method.—When the disease extends upward but little more than an inch, the intestine should be slit up in front, and then drawn out, either with the finger or hooks; ligatures are then carried through it as in hemorrhoidal tumours, and the operation is concluded in the same way.

Summing up.—Vidal (de Cassis) has paid considerable attention to the results of this operation, and has arrived at the following conclusions:—

"The operation rarely removes the whole of the disease, and sometimes hastens the fatal termination. Lisfranc lost three out of nine cases. Velpeau three out of six. Only two of Velpeau's patients were cured, the sixth being affected with incontinence. The operation therefore does not always remove the whole of the disease; the cure is sometimes only partial; and death has been produced within twelve hours. But as death is the inevitable consequence of cancer of the rectum, and as there is a possibility of prolonging life by the performance of an operation, some surgeons consider themselves authorised to attempt it."

Vidal says, when the cancer consists of a mass of tumours, it is always more malignant and more likely to return. If it extends more than an inch above the anus, it is beyond the reach of the knife. In the male it is extremely difficult to separate the rectum from the anterior portion of the prostate gland, which from its color and consistence is very liable to be mistaken for schirrus.

Pinault advises the performance of the operation when the disease does not extend farther up than two inches and a quarter, and is very limited in thickness. In the female, no operation should be performed, if the surgeon on introducing his finger into the vagina discovers that the septum is diseased.

PLUGGING OF THE RECTUM.

Hemorrhage may arise, after the performance of the operations described above, which requires plugging of the rectum to arrest it. We have already described the dressing used by Boyer after the operation for hemorrhoids. Similar methods may be employed according to the nature of the case.

A funnel-shaped compress, inserted so as to form a cul-de-sac in the rectum, and stuffed with lint, or a well soaked bladder introduced into the intestine, and filled with lint, will be found to produce pressure sufficient to arrest any hemorrhage liable to take place.

FOREIGN BODIES IN THE RECTUM.

The mode to be adopted, and the instruments required, to effect a removal of foreign bodies in the rectum, must depend upon their size, shape, and position. The speculum, forceps, lithotomy forceps, etc., will answer the purpose in the great majority of cases. If necessary, an incision of the anus may be made with the knife.

STRICTURE OF THE ANUS AND THE RECTUM.

This disease may be treated by dilatation, or incision.

Dilatation.—Desault dilated the rectum by means of tents soaked in grease, whose size was gradually increased. Gum elastic catheters may also be used for the same purpose.

Costollat introduced a linen bag, by means of a catheter ; this bag he afterwards filled with lint.

Bermond and Fanchou have invented very ingenious apparatus, which may be useful in some cases.

Dilatation is useful when the stricture is some distance up. The preference should be given to those methods which are the most simple, and least painful.

Incision.—This mode of treatment is peculiarly applicable in cases of membranous stricture, without cancerous degeneration. The surgeon introduces his index finger as far as the stricture, and then, laying a probe-pointed bistoury flat upon it, slides it up as far as the constricted point, then turning the edge of the knife towards the stricture, he divides it as he withdraws the instrument. One or more incisions may be made, according to the condition of the disease; a large tent should then be introduced into the rectum.

Crushing, *laceration*, *ligature*, and *cauterisation*, may all be useful in cases which depend upon the presence of tumours, either benign or malignant; but no general rule can be given for this performance.

PROLAPSUS ANI.

In some cases, the prolapsus consists of the mucous membrane of rectum only, which, being loosely connected with the other coats of the gut, occasionally protrudes half an inch, or an inch, beyond the anus; in others, the whole rectum protrudes, drawing the peritoneum along with it.

The modes of treatment adapted to this affection, are: 1st, reduction; 2d, excision; 3d, cauterisation; 4th, excision of the folds radiating from the anus.

1st. *Reduction* is only a palliative form of treatment. The disease returns if the individual stands for a long time, or strains much at stool. Yet, when prolapsus ani supervenes after a long illness, or temporary debility, reduction is the only method of treatment which ought to be employed: the disease disappearing as the strength of the patient increases, and his general health becomes re-established.

If the rectum itself be prolapsed, it should be washed and covered with soft linen compresses; the surgeon then taking it with his left hand, presses upon it moderately, so as to diminish its volume; and now, with the index finger of the right hand, he pushes up the most

extreme point of the tumour, so as to return first those parts which have protruded last. If the tumour be strangulated, an incision of the anus may be made. The whole should be retained by means of a large tent, and a T bandage.

2d. *Excision.*—This method is sure and rapid, and should be performed in the following manner: two or three ligatures should be carried through the base of the tumour, by which it can be retained in position; the whole of it in front of the threads is then removed with the bistoury. It is advisable to tie the arteries as soon as they are divided, and to apply the actual cautery lightly to the surface of the wound.

3d. *Cauterisation.*—By touching the tumour here and there with a knife-shaped cautery iron, heated to a white heat, inodular tissue is formed, which, by its tendency to contract, may prevent a recurrence of the disease.

Treatment by cauterisation sometimes fails, and is only applicable to cases where the tissues are perfectly healthy.

4th. *Excision of the folds radiating from the anus* (plate 71, fig. 2).—Dupuytren advised the removal of a portion of the folds radiating from the anus, to diminish the circumference of the latter, and give more elasticity to the subjacent tissues. Each fold is seized with hooked forceps, and excised with curved scissors. The excision should be carried as far as the anus, and even a little within it, so that the contraction may extend over as large a space as possible. This method frequently fails. Therefore, in severe cases, it is preferable to remove the whole of the tumour.

IMPERFORATE ANUS.

This malformation is frequently congenital, and may be either superficial or deep-seated.

The superficial variety is produced by the skin; the mucous membrane forming a cul-de-sac, a thin cellular layer lying between it and the skin. This variety of imperforation is easily recognised by the violet color of the skin at the anus, and the projection of the septum when the child cries. If the skin be pushed inwards with the finger, the contraction of the sphincter can be felt. The point of the bistoury is thrust into the centre of the spot which is believed to be the extremity of the rectum, when a gush of meconium immediately

follows. A crucial incision of the septum is then made with a probe-pointed bistoury, and each flap removed with the scissors and forceps. A lint tent of the size of the little finger is now introduced into the rectum, which, to prevent contraction of the orifice, is kept in place until complete cicatrization is effected. (Plate 71, fig. 3.)

Deep imperforation, depending upon a septum situated at various distances from the external orifice, is only accessible to instruments introduced by the anus, when the septum is not farther up than one and a half or two inches. If the distance be greater than this, the operation for artificial anus must be performed.

The existence of this deep imperforation is recognized by the absence of stools, the distension of the abdomen, and by the presence of the usual symptoms which characterize retention of fecal matter. The most certain proof is the obstacle which is met with when a catheter is introduced into the anus.

There is no difficulty in performing the operation when the obstruction is within an inch and a half of the anus. A small speculum may be used to dilate the lower part of the rectum, and the septum is punctured with a bistoury, wound with linen, to within a few lines of its point. The meconium immediately escapes. The flaps of the septum may then be excised, and the passage kept open by the introduction of a lint tent, as already described.

Malgaigne's method.—The little finger being introduced into the anus, and the precise position of the septum ascertained, the surgeon must enlarge the anus in front by a single incision with the bistoury; the efforts of the child will then force the septum almost as far down as the external orifice, and plainly into view. The surgeon seizes it with mouse-toothed forceps, makes a crucial incision into it, and excises the two posterior angles, after which he removes the meconium contained in the rectum. The mucous membrane on the inferior portion of the anterior flaps is then removed, and they are brought down and united to the incision in the skin by a few points of interrupted suture.

ABNORMAL ANUS.

The lower portion of the rectum may be wanting, and the anus open into the vagina, bladder, or at some other point of the pelvis.

When the rectum opens into the vagina, two modes of treatment

have been proposed. By one, the perineum and septum are divided as far up as the abnormal anus; a canula is carried through the wound into the rectum, and the whole united together over the instrument, whose opening serves as a continuation of the rectum.

By the other method (Dieffenbach's), neither the perineum nor fourchette are divided, but a puncture is made in the perineum which is carried directly into the rectum. A catheter is then introduced into this puncture, and the abnormal anus is treated as a recto-vaginal fistula.

When the lower portion of the rectum is wanting, the natural anus must be established by making a passage through the tissues into the rectum, or an artificial anus be made. The intestine usually forms a species of bag, filled with meconium, which may be reached by commencing at the natural locality of the anus, and dividing the integuments layer by layer, exploring the bottom of the wound with the finger after each incision with the knife. As soon as the fluctuation of the bag terminating the intestine is recognised, a puncture is made into it, and it is divided in different directions. Dilatation is kept up by introducing tents or a catheter.

When the anus opens into the bladder, it should be treated in the same manner. In performing this operation, the surgeon should keep as near as possible towards the anterior part of the sacrum, to avoid wounding the bladder in the male and the vagina in the female.

Fig. 1.

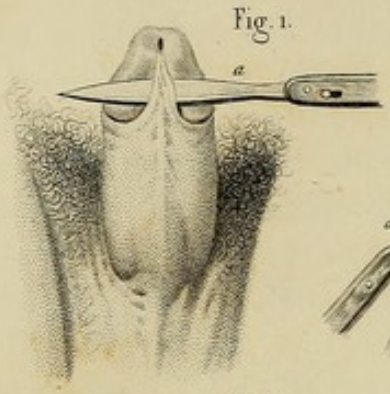


Fig. 2.

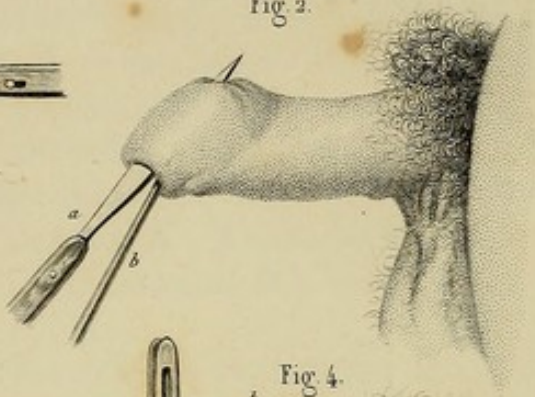


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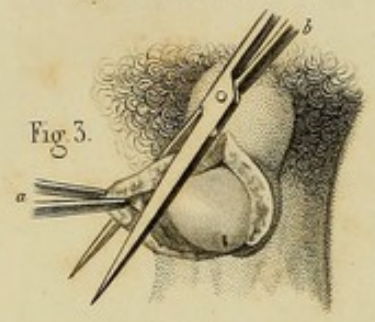


Fig. 4.

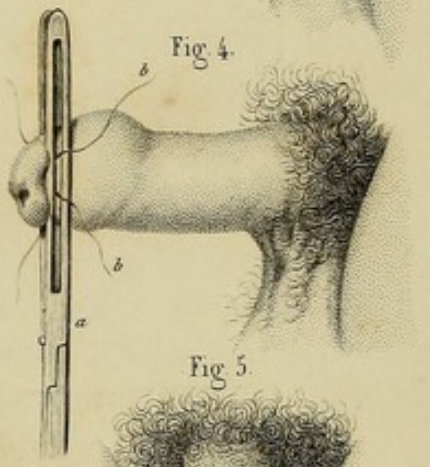


Fig. 4 bis

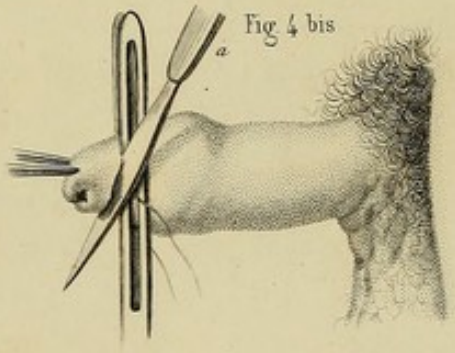


Fig. 5.

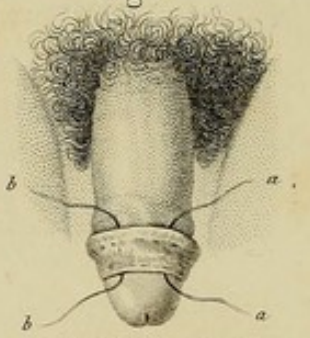


Fig. 5 bis

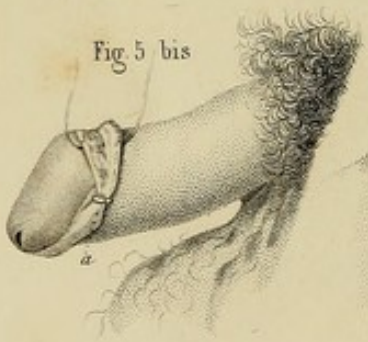


Fig. 6.

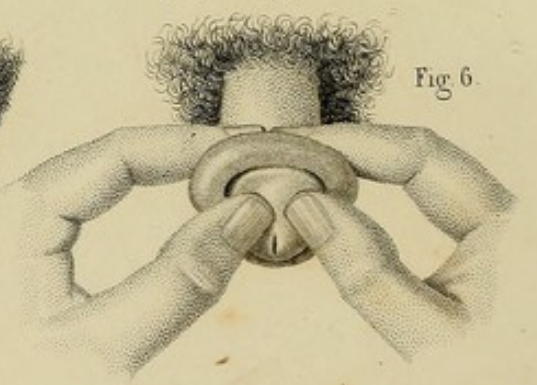


Plate LXXII.

OPERATIONS UPON THE PENIS.

Fig. 1. *Section of the frœnum.*—A bistoury, *a*, is carried through the frœnum to divide it from below upwards.

Fig. 2. *Phymosis.*—A director, *b*, is insinuated between the glans and the prepuce; a bistoury, *a*, slid along the groove of the director, makes a puncture at the upper part of the prepuce, and divides it from within outwards.

Fig. 3. The surgeon, having seized the flaps of the prepuce with the forceps, *a*, is removing them with the scissors, *b*.

Fig. 4. *Circumcision.*—The prepuce has been drawn in front of the glans, and seized with the forceps, *a*, whose jaws have fenestræ cut into them; the ligatures, *b b*, are carried through the fenestræ of the forceps and the prepuce.

Fig. 4 *bis.* 2d *step.*—The bistoury, *a*, is dividing the skin of the prepuce in front of the forceps.

Fig. 5. The prepuce as it appears after the section of the skin. The retraction of the skin is much greater than that of the mucous membrane. *a a*, *b b*, the ligatures.

Fig. 5 *bis.*—The ligature, *a*, has brought together the mucous membrane and the skin.

Fig. 6. *Operation for paraphymosis.—Reduction.*

SECTION OF THE FRŒNUM.

(*Figure* 1.)

This operation can be performed with either the scissors or the bistoury. An assistant holds the glans firmly, and the surgeon drawing out the frœnum puts it upon the stretch. If the scissors are used, it is divided with a single cut; if the bistoury be preferred, it is

thrust through the frœnum from right to left, and divided at once from below upwards.

Union by the first intention is prevented by inserting a little lint between the lips of the wound. No further dressing is required.

PHYMOSIS.

(*Figures* 2 *to* 5 *bis, inclusive.*)

Phymosis may be treated by incision, excision, and circumcision.

1st. *Incision.*—Incision consists in slitting up the prepuce, and may be performed at any point around the glans. *Jules Cloquet* advises the performance of the operation at the inferior portion of the glans, to avoid leaving a visible cicatrix. *Coster* operated by making three short incisions in the free border of the prepuce at equal distances from each other.

The operation can be performed either with scissors or bistouries, of various kinds; the blade being slid as far as necessary beneath the prepuce, and the incision thus effected. A straight bistoury, having a small ball of well oiled wax over its point, may be used; the instrument is slid under the prepuce as far as possible, the surgeon then using it as a lever, and pushing its point through the foreskin, effects the section from behind forwards, by drawing the knife towards himself.

A director, slid under the prepuce (fig. 2), can also be used to guide the instrument. Whatever method is adopted, the skin should be put upon the stretch to make a free and rapid incision.

2d. *Excision.*—Excision is frequently a second step of the operation of incision. When the skin of the prepuce is long, two ugly lateral flaps frequently remain after making the dorsal incision; these should be excised. This is done, by seizing each flap with a pair of forceps, and removing it with the scissors (fig. 3), in such a manner as to leave an even border.

Excision, as a special operation, may be performed either with the scissors or bistoury; a fold of skin is raised up at some convenient point of the prepuce, and excised so as to leave a V shaped, or semi-lunar wound.

3d. *Circumcision.*—This operation removes all of the free border of the prepuce. The surgeon, seizing the prepuce and pulling it for-

wards, grasps all that portion of it extending beyond the glans, with a pair of dressing forceps, and excises it close to the forceps with a single stroke of the bistoury. The forceps being opened, the skin will be found to retract much more than the mucous membrane. The latter should then be slit up in several places, and the flaps turned back and attached to the skin by sutures.

Ricord advised the surgeon to trace out a line with ink, or the nitrate of silver, which shall serve as a guide for incising that portion of the prepuce lying in front of the forceps. By letting the prepuce go after drawing the line, the surgeon can see the extent of the retraction, and make his incision in front of, or behind the line, if such should prove to be necessary.

Circumcision with sutures.—Vidal's method.—Vidal gives the following description of his operation:—"After trying a variety of operations, I now adopt circumcision with suture, by which the mucous membrane of the prepuce is immediately united with the skin. Whatever operation is performed, after excision or incision of the prepuce, the skin retracts much more than the mucous membrane, leaving a large wound, which will inflame, suppurate, and frequently give rise to hemorrhage. Instead of excising this excess of mucous membrane, I turn it back, and fasten it to the skin by points of suture. The simple form of suture may be used, or the threads may be inserted before excision, which can be done in two ways.

"*First method.*—A line is made with ink on the skin of the prepuce, along the line where the sutures are to be inserted, and carried in a direction according with the shape of the glans. The prepuce is allowed to remain in its usual position while this line is being traced. All that portion of the prepuce lying in front of the line is then grasped with dressing, or self-acting forceps, and while the surgeon draws this forwards, an assistant, taking hold of the penis, draws the skin of the organ slightly in the opposite direction. The threads are then inserted along the black line, about two or three lines apart. The prepuce is now pulled forwards, and divided at once with very strong scissors, between the threads and the forceps. The removal of the prepuce makes a wound of variable size, the threads passing over the glans at right angles with the meatus. These threads are divided in the middle, two sutures being formed of each of them, one on each side of the glans. Four threads having

been inserted, will thus form eight points of suture. The needles should be very fine, flat, and lance-shaped at the point. The sutures ought to be removed on the fourth day, by which time union is generally effected. This method presents decided advantages. The results are most satisfactory in regard to appearance. No dressing is required after the operation, except a compress soaked with water."

Figures 4, 4 *bis*, 5, and 5 *bis*, show the different steps of Vidal's method.

PARAPHYMOSIS.

(*Figure* 6.)

Paraphymosis may be *reduced*, or *slit up*, when reduction is impossible.

1st. *Reduction.*—The surgeon seizes the penis in the manner represented in figure 6. Having well oiled the glans, he forces it back with the thumbs, while with the middle and index fingers of each hand he attempts to bring the œdematous prepuce forwards.

Compression by means of a bandage, whose successive turns gradually compress the glans, prepuce, and penis, will sometimes effect reduction in twenty-four or forty-eight hours, when the usual method has failed.

In obstinate cases, the reduction may be facilitated by cold applications, incisions to evacuate the serum, and methodical manipulations to disperse it.

2d. *Slitting up the prepuce.*—When paraphymosis is accompanied by acute inflammation, and the ring formed by the prepuce threatens strangulation, it must be slit up.

The surgeon seizes the penis with the left hand, the thumb resting upon the glans, and the fingers upon the body of the organ; he then inserts the point of a straight bistoury beneath the seat of strangulation, and divides it by raising up the instrument. Incisions can also be made at other points, if necessary; after which the prepuce is scarified to produce a depletion favorable to resolution.

CANCER OF THE PENIS.

Lisfranc directed the attention of surgeons to the real origin and seat of cancer of the penis. This disease only attacks the prepuce, or the skin of the organ, but its growth may be so extensive as to envelope the glans and its entire body. An incision along the dorsum, and parallel with the diseased organ, will show that the body of the penis is perfectly healthy, although surrounded by the cancerous mass. The whole of the diseased portions should be carefully excised, either with the scissors or bistoury.

Plate LXXIII.

CONTINUATION OF OPERATIONS UPON THE PENIS AND SCROTUM.

Fig. 1. *Operation for hydrocele.*—The surgeon grasping the tumour with the left hand *a*, is about making a puncture with a trochar held in the right hand (*fig.* 1, *bis*).

Fig. 2. *Operation for sarcocele.*—Ligature and excision of the arteries of the cord. The cord is brought into view by an incision made along its course; the probe *a* separates the spermatic artery from the rest of the cord.

Fig. 3.—The dissection of a tumour with the bistoury *a*.

Fig. 4. *Amputation of the penis.*—The surgeon having applied a bandage to the free extremity of the penis, is holding it with one hand, while an assistant *b* draws back the skin towards the pubes; the amputation is being performed with the bistoury *c*.

HYDROCELE.

(*Plate* 73, *fig.* 1, *and* 1 *bis.*)

The general title of hydrocele is given to all tumours of the scrotum formed by an accumulation of serum. When serum is infiltrated into the cellular tissue of the scrotum, it is called *œdema*. When it is effused into the tunica vaginalis, it constitutes true hydrocele. Œdema of the scrotum is frequently a consequence of general disease, and is usually treated by making numerous punctures. The spermatic cord, as well as the tunica vaginalis, may be the seat of hydrocele by effusion. Hydrocele of the tunica vaginalis communicates with the peritoneum (*congenital hydrocele*), when the canal of Nuck is not obliterated. This peculiarity contra-indicates most of the operations performed for hydrocele of the tunica vaginalis.

Hydrocele of the cord may be treated in the same way as hydrocele

Pl. 73.

Fig. 1

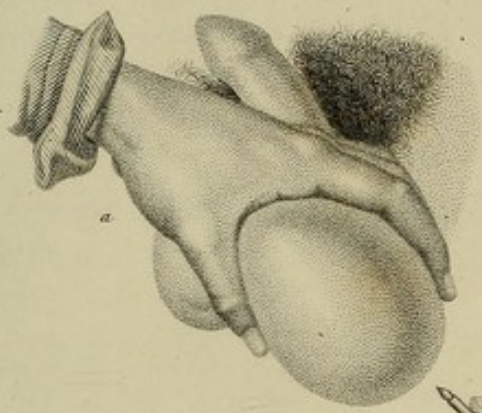
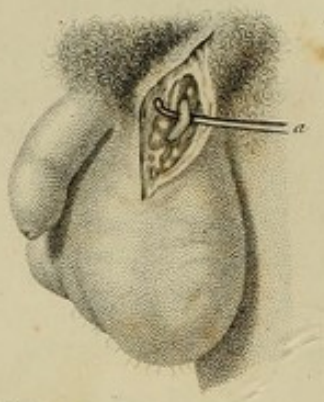


Fig. 2



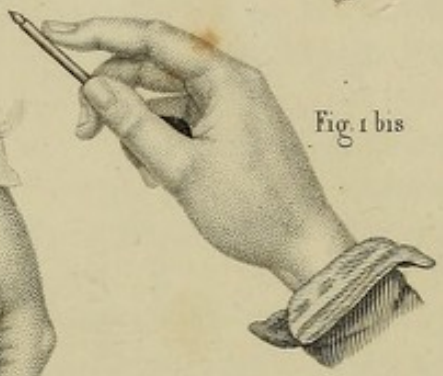
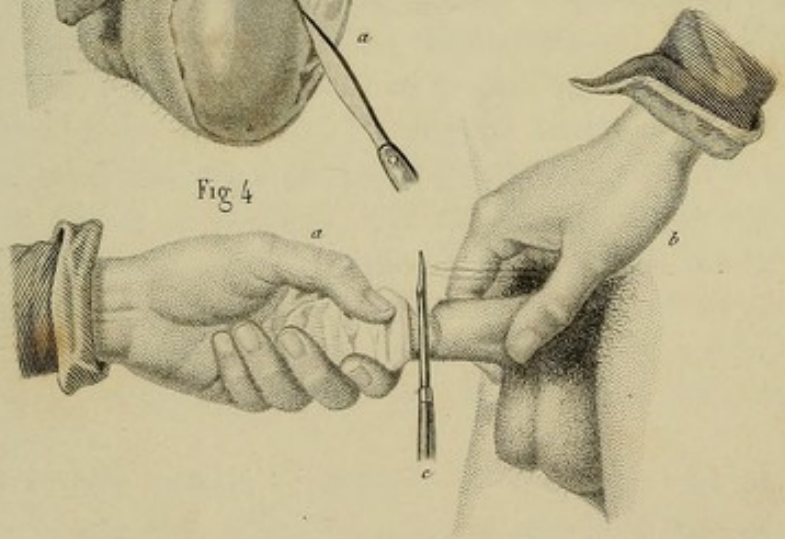


Fig. 1 bis

Fig. 3



Fig. 4



of the tunica vaginalis. But the anatomical relations of the tumour with the organs which compose the spermatic cord, and its vicinity to the peritoneum, should render the surgeon cautious in the use of irritating injections. The operation by incision is therefore to be preferred.

The treatment of hydrocele is either palliative or radical. The palliative treatment consists in evacuating the fluid contained in the tunica vaginalis, either by puncture or incision. But after this simple operation, the serum again accumulates in the scrotum, and reproduces the disease. To effect a radical cure, a change in the surface of the serous membrane must be produced, so as to prevent it from again secreting fluid.

The methods employed for the cure of hydrocele are, puncture, incision, excision, cauterisation, the seton, the suture, and injection.

Puncture.—This operation is either performed with a lancet, or acupuncture needles. In doubtful cases, it is prudent to make exploring punctures; but when the nature of the case is well made out, a small trochar is the most suitable instrument for making the puncture. The patient lying down, the surgeon should grasp the tumour with the whole hand, and making methodical pressure, put the integuments upon the stretch; the anterior and inferior portion of the tumour should be allowed to project between the thumb and index finger of the left hand; the surgeon having previously ascertained the exact position of the testicle, takes the trochar in his right hand, and thrusts it obliquely into the antero-inferior part of the serotum, limiting the extent of its insertion by placing his fore-finger upon the instrument, to avoid wounding the testicle. The stem of the trochar is then removed, and the canula held firmly in place during the escape of the fluid, to prevent any infiltration of the serum into the scrotum.

Incision.—The tumour is grasped in the same way as in the operation for puncture. The surgeon proceeds to divide each layer by itself, until he reaches the tunica vaginalis, into which he makes an exploring puncture, or he may open it at once; then, enlarging the incision above and below, he fills the sac with lint, either dry, or soaked in warm wine.

Excision.—Boyer advises the surgeon to make an incision of the skin, and dissecting it up extensively in different directions, to remove as much as he can of the tunica vaginalis. This operation has been

modified in various ways by different surgeons. Excision is proper when the tunica vaginalis is thick and indurated, but in the great majority of cases, incision is to be preferred.

Cauterisation consists in producing an eschar at the lower part of the tumour, by the application of caustic potash, the action of the caustic extending to the tunica vaginalis. This operation is now abandoned.

The insertion of the *seton*, *lint tents*, and other *foreign bodies* into the interior of the tumour, is now very generally disapproved of.

Injection.—This method, which was described by Celsus, is at present generally adopted. Puncture, as already described, constitutes the first step. When the sac is emptied, the surgeon injects into its cavity some irritating liquid, which will produce an adhesive inflammation of the interior of the tunica vaginalis, which prevents any reproduction of the disease.

Wine, or the tincture of iodine, is usually employed for injections; from eight to fifteen parts of the tincture to thirty parts of water. The liquid should be very nearly of the temperature of the body, and the quantity employed must be proportioned to the size of the tumour.

A silver or pewter syringe, large enough to hold several ounces, should be used, and its nozzle should be shaped so that it can be fitted accurately into the canula.

The serum having been completely evacuated, the surgeon grasps a portion of the skin surrounding the canula, and holds it firmly around the instrument. An assistant then introduces the nozzle of the syringe into the canula, and slowly, but continuously, forces the irritating liquid into the sac until it is completely filled, which being effected, the syringe is withdrawn, and the surgeon applying his finger over the mouth of the canula, to prevent the escape of the liquid, retains it within the scrotum for two or three minutes. If acute pain is not produced in the course of three or four minutes, the fluid is allowed to escape, and the sac is injected a second time. If the patient experiences acute pain along the spermatic cord and in the region of the kidneys, and also in the testicles, the liquid may then be discharged by pressing upon the tumour.

It is very important during this second step of the operation, that the canula should be held firmly in place, to prevent the injection from escaping into the cellular tissue of the scrotum, and producing

gangrene. If this accident should happen, the surgeon must make large incisions to facilitate the escape of the infiltrated liquid.

The second step of the operation being concluded, the scrotum must now be covered with compresses soaked in the liquid used for the injection. In the course of twenty-four hours, the tumour becomes inflamed, enlarged, hard and painful, which symptoms slowly subside, adhesions form, and in fifteen or twenty days the disease is cured. Suppurative inflammation occasionally takes place, but this by no means prevents the radical cure of the disease.*

SARCOCELE.

(*Plate* 73, *fig.* 2 *and* 3.)

Malignant tumours of the testicle may be treated by *ligature of the spermatic vessels*, and by *castration*.

1st. *Ligature of the spermatic vessels*, fig. 2.—*Maunoir's method*—An incision from an inch and a half to two inches in length, just below the external ring, brings the spermatic cord into view; the spermatic artery is isolated from the rest of the cord, and tied with two ligatures, between which it is divided.

Morgan's method.—Morgan removes the vas deferens, and leaves the vessels untouched.

Both of these operations are tedious and painful, and sometimes fail to produce atrophy of the tumour. Castration is therefore usually preferred.

2d. *Castration*, fig. 3.—There are two steps to this operation; 1st,

* As a material for injection for the radical cure of hydrocele, the Tinct. Iodine Composita, of the United States Pharmacopeia, is preferable to the simple tincture of Iodine, as the former is not decomposed by dilution with water. The compound tincture is similar in composition to Lugol's solution. It may be injected of the strength of one part to two or three of water. The easiest and most efficient mode of performing the operation is to employ a small glass or pewter syringe, such as is used for the urethra, to inject from ʒ ij. to ʒ ss. of the fluid, according to the size of the hydrocele, and to withdraw the canula immediately, allowing the Iodine mixture to remain in the tunica vaginalis. Solutions of Iodine are preferable to wine for injections in hydrocele, inasmuch as they are not liable to give rise to sloughing, if accidentally injected into the cellular tissue of the scrotum.—Ed.

The incision of the skin and exposure of the tumour; 2d, The division of the spermatic cord.

1st *Step.*—The skin in front of the tumour is divided by an incision commencing at the external ring, and carried down to the most dependent portion of the tumour. When the skin does not adhere to the tumour, the latter is easily separated from it by enucleation; but if adhesion has taken place, the tumour must be separated, by dissection, from the integuments, provided the latter are not involved in the disease. If the tumour is very large, a portion of the scrotum should be removed with it.

2d *Step.*—The tumour being separated from the integuments, is supported only by the cord, and should be held by an assistant. The cord may be divided at once, and the arteries tied after the removal of the tumour, or it may be divided by degrees, and the vessels tied as they are cut.

When the cord is divided with a single stroke of the knife, it retracts and draws up the vessels, so as to occasion difficulty in securing them. It has therefore been advised to put a ligature around the entire cord before dividing it, or to prevent its retraction by means of a hook.

Larry describes a fatty hypertrophy of the envelopes of the testicle, under the title of *oscheochalasia*, the testicle itself not being diseased. The surgeon, in performing an operation for this disease, should only remove the diseased envelopes, leaving the testicle itself intact.

AMPUTATION OF THE PENIS.

(*Plate* 73, *fig.* 4.)

When cancer attacks the body of the penis, amputation of the organ is demanded. An assistant takes hold of the penis near its root, and the surgeon, after applying a bandage to its free extremity, grasps it firmly with his left hand and removes it with a single stroke of the knife.

The corpora cavernosa are more retractile than the skin; therefore the assistant ought not to pull too much upon the integuments of the penis, for if the flap of skin is too long it hinders cicatrisation, and also the free discharge of urine from the urethra. The corpora caver-

nosa retract in proportion to their length, hence the nearer the operation is performed to the scrotum the more skin should be preserved.

After the performance of the amputation, the arteries must be tied, and a catheter introduced into the urethra, which is to be permanently retained. The catheter requires changing frequently, but should be retained until cicatrisation is complete. On account of the difficulty sometimes experienced in introducing the catheter after the performance of the operation, Barthelemy advises the surgeon to introduce it first, and to amputate it and the penis together.

Ricord's method.—In a case of phagedenic chancre, which had destroyed half of the penis, Ricord performed amputation of the organ with a single stroke of a knife, heated to a white heat. He has adopted this method in order to prevent the sound parts from being inoculated with the disease, which is unavoidable when any of the ordinary operations are performed.

Plate LXXIV.

OPERATION FOR VARICOCELE.

Fig. 1. *Compression of the varicocele with Breschet's forceps, a a.*

Fig. 2. *Twisted suture.—Velpeau's method.*—A pin, *a*, has been passed under the bundle of varicose veins; the thread, *b b*, forms a twisted suture around the pin.

Fig. 3, 4, and 4 *bis. Ligature.—Ricord's method.*—Fig. 3, the first loop of thread, *a*, has been passed beneath the varicose veins. Fig. 4, a second thread inserted and brought out at the same openings with the first thread, is passed in front of the veins. Loops are formed by the ends of the threads, *c* and *d*; *a*, the veins; *b*, the vas deferens, lying behind and not included in the ligature.

Fig. 4 *bis.* The veins strangulated beneath the skin by the loops of thread.

Fig. 5. *Rolling up of the veins.—Method of Vidal* (*de Cassis*).—*a a'*, needles of the proper size, lance-shaped at their points; a screw is cut in the orifices at the other extremities, into which two pieces of fine silver wire, *b* and *b'*, are screwed. The needle *a*, which is larger than the other, is used to insert the posterior wire.

Fig. 6. The varicose veins, *a a*, lying between the silver wires, *b* and *c*. The vas deferens, *d*, lies behind the veins.

Fig. 7. *The veins rolled up by twisting the wires.*

Fig. 8. *Appearance of the wires after thorough twisting.*

VARICOCELE.

Varicocele may be radically cured by means of compression, the twisted suture, ligature, and rolling up of the veins.

1st. *Compression.—Breschet's method* (plate 74, fig. 1).—This method consists in applying to the varicose veins two iron forceps,

Pl. 74

Fig. 1.

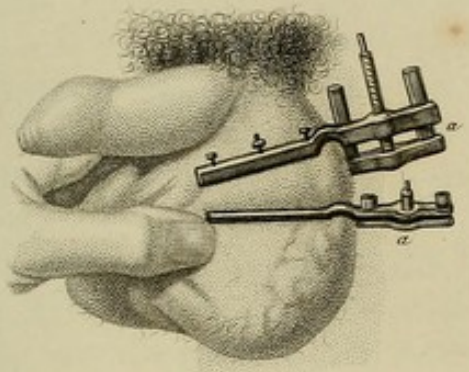


Fig. 2

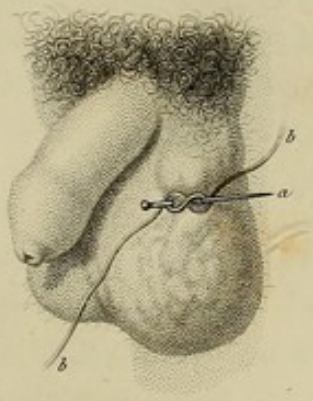


Fig. 3

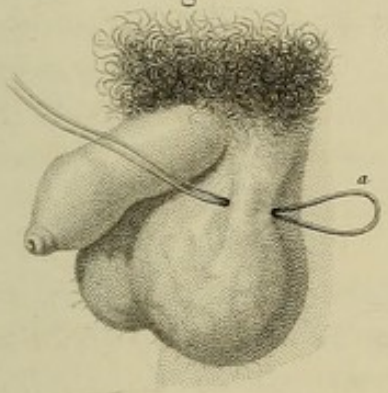


Fig. 4

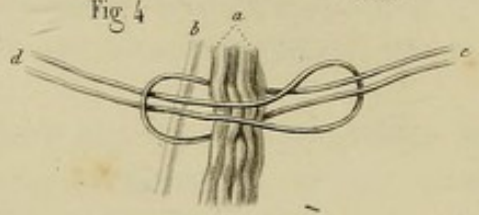


Fig. 4 bis

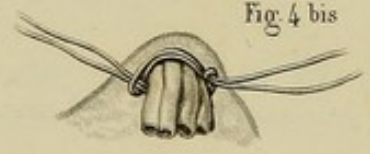
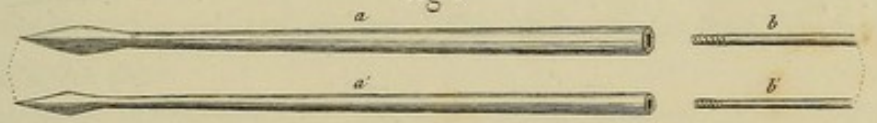


Fig. 5



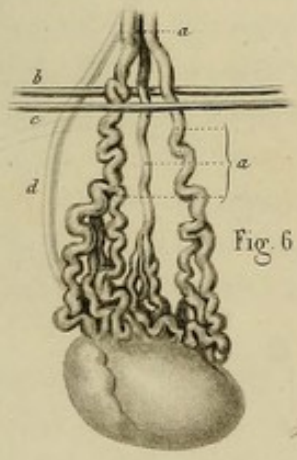


Fig. 6

Fig. 7

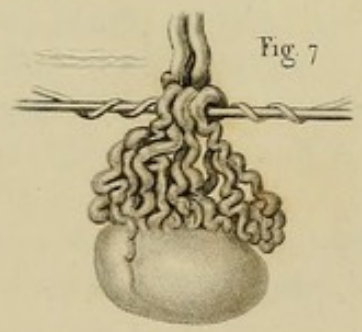
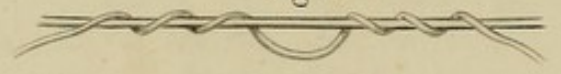


Fig. 8.



whose jaws are gradually tightened by means of a thumb-screw. The result is a slow section of the soft parts, together with the veins.

Before applying the forceps, the patient should be directed to walk about or to take a warm bath, to dilate the veins; the vas deferens and the spermatic artery, which lie close together, must be carefully separated from the veins, to prevent their strangulation. The vas deferens is easily recognised by its hardness, regularity, and the painful sensation produced by squeezing it. All of the varicose veins must be included between the jaws of the forceps, which are placed about an inch apart, the upper one being first attached. These forceps have been modified by Landouzy, so that they do not compress the external border of the skin. The time required for producing the sloughs varies according to the degree of compression. The wounds heal rapidly.

2d. *Suture.—Velpeau's method* (fig. 2).—This operation can be performed in two ways. One, by taking up the varicose veins in a fold of the skin, and passing a pin behind them, then making a suture, or rather, a simple ligature.

The other way consists in introducing two pins, one before, and the other behind the varicose veins, which are then compressed by carrying a ligature around the extremities of the pins in the same manner as in making the twisted suture. The varicocele is thus compressed between the pins.

Ligature.—Reynaud (of Toulon), introduces a curved needle, threaded with a ligature, behind the bundle of veins, and brings it out again about two-thirds of an inch from the place of entrance, inclosing the dilated vessels. The ends of the ligature are then firmly tied over a roll of linen, or paper. The vessels are divided in the course of fifteen or eighteen days.

Gagnebé brings the ligature out at the same place where it was introduced, strangulating the veins by the loop formed under the skin.

Ricord's method (fig. 3, 4, and 4 *bis*).—The bundle of veins is isolated, and taken up in a fold of the skin; the first loop is carried behind the veins, fig. 3, *a*. A second loop is then passed in the opposite direction, in front of the veins, through the same orifices as the first. The bundle of veins, *a*, fig. 4, is thus included between two loops. The free extremity of each thread is then passed through the loop of the other, as is seen in fig. 4. By pulling upon the threads,

the veins are strangulated beneath the skin, fig. 4 *bis*. The strangulation can be kept up, by fastening the ends of the threads to a knottyer.

Vidal's method.—Rolling up of the veins of the spermatic cord, fig. 5, 6, 7, and 8.—The first step consists in passing a silver wire behind the veins of the spermatic cord. The wire, *b*, is attached to the needle, *a* (fig. 5). The surgeon then separating the vas deferens from the veins, passes the needle through the scrotum, between them, guiding its course with the fore-finger and thumb. The second and smaller needle, *a'*, with the wire, *b'*, attached, is then passed through in front of the veins, thus including these vessels between the two wires. This is effected by pinching up the skin in front of the veins with the fore-finger and thumb, and bending slightly forward the wire already inserted, by which means the orifices already made are brought much nearer to each other. The second needle can thus be introduced, and brought out at the same orifices as the first. When the anterior wire is fairly introduced, the first wire must be straightened, by which the former is slightly curved. The veins are thus included between the two wires. Figure 6 shows the varicose veins, *a a*, the testicle and vas deferens, *d*, the latter being pushed aside, instead of occupying its usual position close to the middle vein. The surgeon now proceeds to twist the ends of the wires. As the twisting goes on the veins are gradually rolled around the wires, fig. 7, the vas deferens remaining wholly intact.

The testicle, to which the inferior extremities of the veins are attached, being movable, is gradually drawn up towards the abdomen, as the twisting goes on. The laxity of the cellular tissue of the scrotum favors this drawing up of the testicle.

Figure 8 represents the appearance of the wires after thorough twisting; one of the wires is larger than the other—the smaller winding around the larger, leaving a species of loop in the centre, which gradually grows smaller as the twisting of the wires is continued. A small ball of linen is then placed upon the skin, between the two orifices, and the wires are kept firmly in place by twisting their extremities over it. A director is now passed through this new loop formed by the wires, by which they are twisted anew.

By this operation, we have, 1st, A rolling of the veins over the wires; 2d, A compression of these veins between the wires; 3d, A section of these vessels at different points; the number of points

depending upon the number of turns which have been given to the wires. The wires may be allowed to remain until they cut through the skin, by doing which the superficial veins lying between the skin and the cord, will be also divided, which will tend still farther towards preventing a return of the disease. Besides, by rolling the principal veins of the cord around the wires, a number of small venous branches are drawn along with them, which would not be included in ordinary ligatures. By this operation, therefore, not only the veins of the cord itself are compressed as in the ordinary operations, but also the adjacent veins permeating the different tissues of the scrotum, including the cutaneous and sub-cutaneous veins. In varicocele of long standing, when the superficial veins are also varicose, they should also be included in the ligature, which is effected by this operation.

Malgaigne, taking into consideration the fact that all of these methods have effected cures, and that they have also been succeeded by relapses, gives the preference to such as produce the least destruction of the soft parts, and therefore recommends the sub-cutaneous ligature (*Gagnebé*) which is tightened over a roll of sticking plaster.*

* Varicocele is so common a disease in young men, and so frequently the source of unnecessary and exaggerated anxiety, that it is well to bear in mind that in the great majority of cases palliative measures, such as the use of a well-fitted suspensory bandage, and daily bathing in cold water, are the only remedies required. The operations described above are not always free from danger, and they are only justifiable where the disease gives rise to serious pain, or when its increase of size threatens atrophy to the testicle.—Ed.

Plate LXXV.

OPERATIONS UPON THE BLADDER AND URETHRA.

Fig. 1. *Puncture of the bladder above the pubes.*—This figure represents a section of the perineum in the median line, showing the relations of the bladder with the adjacent organs.

a, the meatus urinarius; *b*, the commencement of the urethra, or the neck of the bladder; *c*, the interior of the bladder; *d*, symphysis pubis; *e*, fibro-cellular tissue, lying between the prostate gland and the arch of the pubes; *f*, the bulb of the urethra, divided along the median line; *g*, septum of the dartos; *h*, posterior lobe of the prostate gland; *i*, the rectum intact; *k*, the top of the bladder, or urachus, the point where the peritoneum is reflected upon the anterior wall of the abdomen; *l*, a curved trochar, in the position in which it is used by a surgeon in puncturing the bladder above the pubes.

Fig. 2. *Puncture of the bladder through the perineum.*—The figure represents the perineum completely exposed, as in the operation for lithotomy. *a*, the place of election for puncturing the bladder, situated between the urethra and the ramus of the ischium about half an inch in front of the margin of the anus; *b*, the projection of the bulb of the urethra beneath the skin; *c*, the anus.

Fig. 3. *Puncture of the bladder by the rectum.*—The figure represents a section through the median plane of the pelvis, to show the relations of the bladder with the rectum.

a, the bulb of the urethra divided in the median line; *b*, the posterior lobe of the prostate gland; *c*, the interior of the bladder; *d*, the top of the bladder, or the urachus; *e*, symphysis pubis; *f*, the forefinger of the surgeon's right hand introduced into the rectum, and serving as a guide for the curved trochar, which is represented as having just perforated the bas-fond of the bladder.

Pl. 75.

Fig

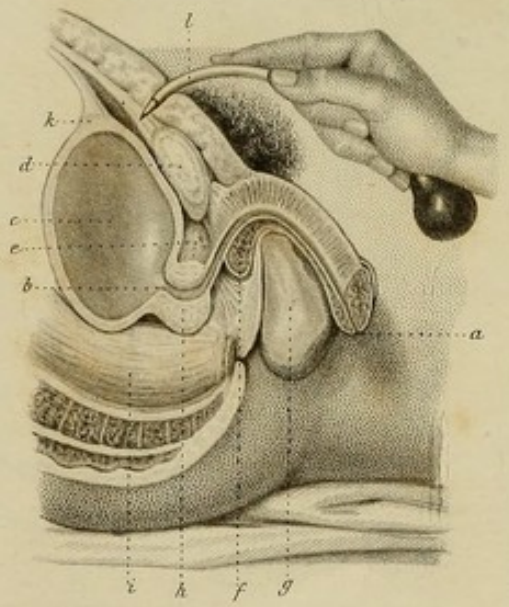
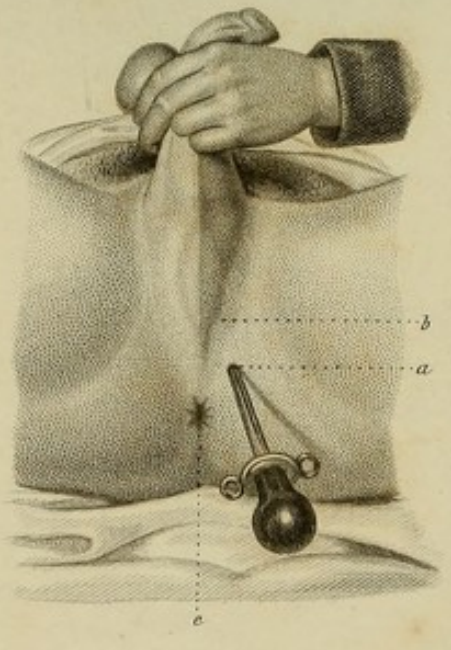


Fig.



Fig



PUNCTURE OF THE BLADDER.

Puncture of the bladder is an operation which is becoming less and less frequent, as strictures of the urethra and other causes which produce retention of urine, are being better understood. The operation should only be performed when the retention of urine is considerable, and relief cannot be obtained by milder means. In addition to a thorough examination of all the symptoms and antecedents, the surgeon, before performing the operation, should carefully percuss the bladder to discover the extent of its distension and repletion, to avoid performing the operation without an absolute necessity.

The operation being determined upon, there should be no delay in performing it. Cases of rupture of the bladder have occurred where the urine has been retained for thirty-six or forty-eight hours, giving rise to dangerous symptoms which might have been avoided by its timely puncture.

There are three modes of puncturing the bladder: 1st, By the hypogastrium; 2d, By the perineum; 3d, By the rectum.

There is a fourth method of penetrating the bladder by the urethra, but this is generally called forced catheterism (see *forced catheterism*).

1st. *Puncture above the pubes* (fig. 1).—When retention of urine demands the performance of this operation, the bladder is distended and elevated above the pubes, pushing up the peritoneum, its anterior superior aspect lying in contact with the muscles of the abdominal parietes.

To perform the operation, the patient should be laid upon the right side of the bed, his head and chest somewhat elevated and the thighs slightly flexed. The surgeon, after satisfactorily recognising the superior border of the pubes, takes the curved trochar of frère Côme in his right hand, and plunges it perpendicularly into the median line about an inch and a half above the symphysis pubis. The puncture should be made with a single thrust, as in performing the operation of paracentesis. When the instrument has entered the bladder, the trochar must be withdrawn and the urine be permitted to escape through the canula. The bladder being emptied, the canula is stopped with a wooden plug and retained in position by pieces of tape carried around the body. The canula must not be thrust in too far, lest it injure the coats of the bladder; neither must it be too short, for the retraction of the bladder would draw it out, and it would be

left sticking in the cellular tissue. The trochar of frère Côme, which is used in performing the operation, is about four inches in length, and its curve forms the segment of a circle of some six inches in diameter.

The canula should be retained in the bladder until the urine escapes through the usual passages, either through the efforts of nature, or by the use of the catheter. The plug should be frequently taken out of the canula, and the patient placed on his side to evacuate the bladder.

In the course of a few days, the passage through which the canula enters the bladder is lined with a coating of mucus, and the instrument can then be removed without any risk of the infiltration of urine into the cellular tissue.

2d. *Perineal puncture* (fig. 2).—The patient being laid upon his back, with the legs and thighs bent, and the scrotum drawn up by an assistant—the position being the same as that for lithotomy—the puncture is made with a straight trochar, about six or seven inches in length. The surgeon stands between the patient's thighs, and puts the skin on the stretch, by applying his left index-finger on the side of the raphé, between the urethra and the ramus of the ischium, about four or five lines in front of the anus. Then, taking the trochar in his right hand, he introduces it about the middle of a line drawn from the tuberosity of the ischium to the raphé, about two lines in front of the margin of the anus. The instrument should be directed forward and inward, so as to come directly upon the neck of the bladder, after passing successively through the skin, the adipose cellular tissue, the levator ani muscle, and the bas-fond of the bladder, near its neck. The surgeon recognises the penetration of the bladder, by the absence of all resistance to the farther introduction of the instrument, and the passage of a few drops of urine along the canula, when he withdraws the trochar, and allows the urine to escape. The bladder being evacuated, he plugs the canula, and fastens it in its position by means of a T bandage. The rest of the treatment is the same as that already described for the previous operation.

3d. *Puncture by the rectum* (fig. 3).—The patient being placed in the position for lithotomy, the surgeon, oiling the index-finger of his left hand, introduces it into the bowel, where he feels very distinctly the tumour produced by the bas-fond of the bladder, which projects into the rectum, and occasionally compresses it to so great a degree as

to prevent the passage of the feces. The surgeon then takes a curved trochar, of some four or five inches in length, in his right hand, and drawing the point of the instrument just within the canula, slides its convex portion along the index-finger already in the rectum, until it passes beyond the end of the finger and comes in contact with the anterior wall of the rectum, when, grasping the handle of the instrument, with a sudden thrust he pushes it into the bladder.

Instead of one finger, the surgeon may introduce two into the rectum, and slide the trochar along between them, thus giving greater protection to the adjacent parts. If the operation be performed in this way, there is no need of drawing the point of the trochar within the canula.

The puncture should be made through the bas-fond of the bladder, above the prostate gland and between the vesiculæ seminales, consequently below the cul-de-sac formed by the reflection of the peritoneum from the rectum upon the bladder. The instrument ought not to penetrate more than an inch into the bladder.

After the puncture is effected, the index-finger must be withdrawn from the rectum and then the trochar itself, when the urine will escape through the canula. The bladder being emptied, the canula is secured in its position by threads carried through the rings attached to the extremity of the instrument, which are fastened before and behind to a bandage passed around the body. Compresses are also applied around the canula, and the whole secured by a T bandage. The patient should be required to remain in bed, so that the canula can be permanently retained, into which a plug may be inserted, which must be removed occasionally to empty the bladder. When the patient has a stool, the T bandage must necessarily be removed, and the canula must be slightly raised up and held firmly in its position, to prevent it from being forced out of the bladder during the efforts of defecation.

The canula must be retained until the urine passes through the natural passages. Some authors, however, fearing that dangerous consequences may result from keeping the canula too long in the bladder, recommend the performance of successive punctures. At any rate, it is absolutely necessary to retain the canula for at least twenty-four hours, until the inflammation which follows in the wound will prevent the infiltration of urine into the cellular tissue lying

between the rectum and bladder. A fistulous opening is the result, through which the urine escapes into the rectum.

Summing up of these different methods.—Of the three methods which we have described, puncture by the hypogastrium is generally preferred, on account of the small number of important organs in the vicinity, and the very moderate thickness of the tissues through which the instrument is required to pass.

In puncture by the rectum, if the instrument be not carried exactly through the middle of the bas-fond of the bladder, there is danger of wounding either the peritoneum, the vasa deferentia, the vesiculæ seminales, and even the ureters; besides, after the puncture is effected, the wound is much more liable to remain fistulous, the function and varying relations of the rectum tending to prevent its cicatrisation.

By the perineal puncture, there is also danger of wounding the peritoneum, the prostate gland and the vessels of the perineum. The sole advantage of this operation over that through the rectum, is, that there is less probability of a fistulous passage being the result; but, as a balance to this, it must be acknowledged that a canula in the perineum is more annoying and inconvenient than in any other locality.

Puncture of the bladder above the pubes does not expose the patient to the same dangers as when the operation is performed in other localities; the peritoneum alone is liable to be wounded, but there is no danger of this when the bladder is so distended as to require the performance of the operation. When the bladder is punctured at this point, however, there is more danger of infiltration of urine, or of the formation of urinary abscesses, because the opening is not situated in the most depending portion of the bladder, and hence there is more difficulty in emptying it completely. Besides the relative position of the bladder to the adjacent organs, there are other indications, both in favor of and against the performance of the operation by either of the methods which have been described. The presence of various kinds of tumours in the perineum, or the immediate vicinity of the rectum, are indications against the perineal, or rectal punctures, thus compelling the surgeon to perform the operation above the pubes. So, puncture above the pubes is contra-indicated if the retention of urine is caused by contusions, or inflammations, in the hypogastric

region. If the patient be fat, the difficulty of performing the operation is considerably increased, no matter what method may be preferred. The mass of tissues occupying the perineum increases the distance between the bladder and the external parts; in such cases, puncture above the pubes is the shortest way of arriving at the bladder, particularly if the surgeon, as is often necessary, divides the parts down to the tendons of the muscles before he uses the trochar to make the puncture.

In either operation, if it be desirable to retain the canula for a considerable period of time, it is advisable, in the course of a few days, to substitute a gum-elastic catheter for the metallic canula; the former being the smaller, must be passed through the canal of the latter into the bladder. In this way, urinary incrustations are avoided, it being generally believed that they are more liable to form upon metallic than upon other catheters.

Plate LXXVI.

CONTINUATION OF OPERATIONS UPON THE BLADDER AND URETHRA.

Fig. 1. Antero-posterior section along the median line, showing the course of the urethra, the relations of the bladder with the rectum, &c., &c. *a'*, the neck of the bladder; *b*, the cavity of the bladder; *c*, the point where the ureters open into the bladder; *d*, the top of the bladder; *a*, the glans penis; *l*, the corpus cavernosum; *e*, the prostate gland; *f*, the bulb of the urethra; *g*, the vesiculæ seminales; *h*, the anterior portion of the prostate gland; *i*, the symphysis pubis; *k*, the rectum.

Fig. 2. *Catheterism.*—Introduction of the catheter into the meatus urinarius. *a*, the external orifice of the urethra, into which the catheter is about being inserted; *b*, the cavity of the bladder; *c*, the opening of the urethra into the bas-fond of the bladder; *d*, top of the bladder; *a'*, the neck; *e*, the posterior part of the prostate gland; *f*, the bulb of the urethra; *h*, the anterior portion of the prostate gland; *i*, the symphysis pubis; *l*, the inferior wall of the urethra.

Fig. 3. *Catheterism.*—The catheter is introduced as far as the prostatic portion of the urethra, the penis itself being held up towards the abdomen. *a*, the meatus urinarius; *b*, the cavity of the bladder; *c*, the point where the ureter opens into the bladder; *d*, the top of the bladder; *a'*, the point of the catheter at the prostatic portion of the urethra; *e*, the prostate gland; *f*, the bulb of the urethra; *i*, the symphysis pubis; *l*, the catheter passed through the spongy portion of the urethra.

Fig. 4. *Catheterism.*—The penis having been depressed to a horizontal position, the catheter has entered the bladder. *a*, the meatus urinarius; *b*, the extremity of the catheter in the cavity of the bladder; *c*, the ureter; *e h*, the prostate gland; *f*, the bulb of the urethra; *g*, the vesiculæ seminales; *i*, the symphysis pubis; *k*, the rectum; *l*, inferior wall of the urethra.

Pl. 76

Fig 1

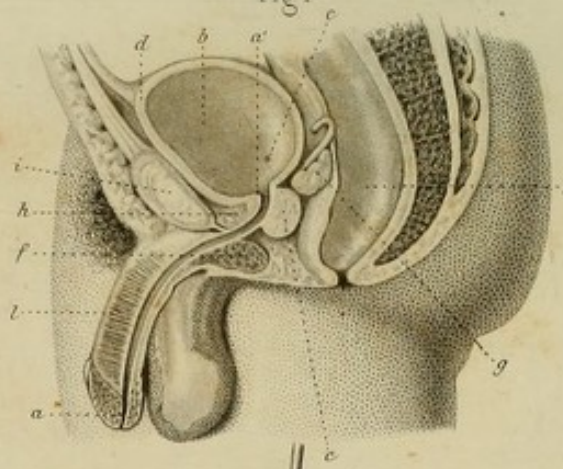
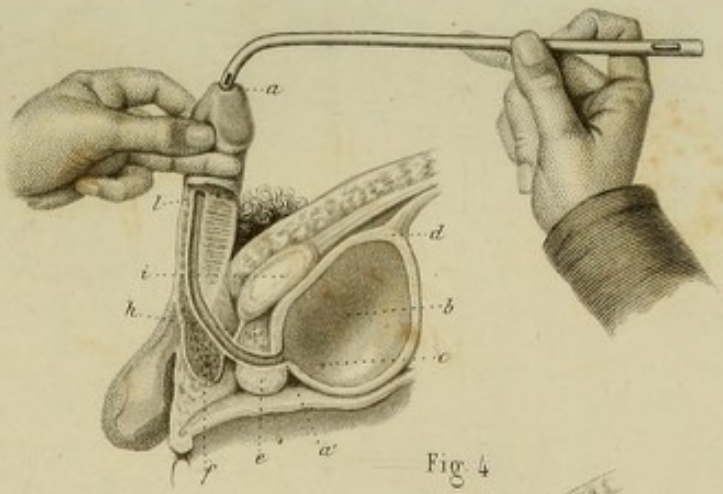


Fig. 2.



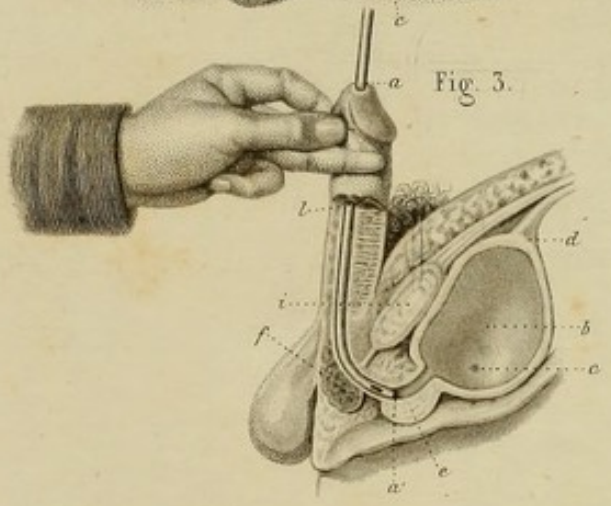
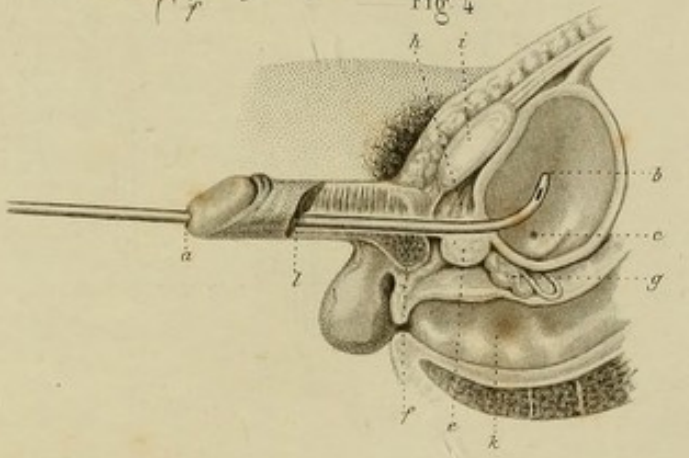


Fig. 3.

Fig 4



SURGICAL ANATOMY OF THE URETHRA.

In the male, the urethra is the passage through which the urine and the semen are discharged; in the female, the urine alone passes through it.

The male urethra is divided into three portions: 1st, The prostatic portion, which comprises all that part lying between the neck of the bladder and the membranous portion, being surrounded by the prostate gland; it is about one inch in length. 2d, The membranous portion, comprising that portion of the canal which is surrounded by muscular fibres, on which account it has also had the name of muscular portion given to it; it extends to the spongy portion, and is about five-sixths of an inch in length; it is slightly curved, the concavity looking forwards and upwards; the inferior wall is the longest, but is the least accessible, being covered with the bulb, which in some persons is almost in contact with the inferior border of the prostate gland. 3d, The third portion is called spongy, on account of its structure; it commences at the membranous portion, and terminates at the meatus.

From its direction and its situation, Malgaigne divides the spongy portion of the urethra into two secondary regions, the sub-pubic region, which extends to the suspensory ligament, and the penal region, which includes all that portion belonging to the penis proper. Taken together, these two portions measure from three to six inches in length, the sub-pubic portion being two-thirds of an inch.

The length and direction of the urethra differ in individuals, and also depend upon the condition of the penis, whether it is flaccid or in a state of erection; the calibre and structure of its various portions vary according to circumstances.

Length.—There has been a great diversity of opinion upon this subject, authors having varied in their estimates, from five to fourteen inches. Malgaigne has shown that these variations depend in a great degree upon the manner in which the measurement is made. Numerous experiments have proved to him that the urethra, the penis being flaccid, varies from five inches and two lines to six inches in length, the average being about five inches and a half. When the penis is in a state of erection, or is pulled upon, the length is increased, and may, under such circumstances, reach as far as seven inches and

a half. If the urethra be dissected out, or detached from its connections, it may extend to ten inches, and even considerably more.

The tumefaction which frequently arises during the performance of catheterism slightly increases the length of the canal. These facts already enumerated, prove that a catheter seven inches in length would readily pass into the bladder, and that no more than eight inches ought ever to be inserted when it is to be permanently retained, this distance being amply sufficient even when the penis is in a state of erection.

Course.—When the penis is flaccid, the urethra has the form of the letter S; the penal portion forms, with the sub-pubic portion, an acute angle, open below, the summit corresponding with the point where the suspensory ligament is attached. The penal portion is almost vertical, while the second is oblique, downwards and backwards. This angle no longer exists when the penis is in a state of erection, or when it is drawn up so that it makes an angle of forty-five degrees, open above, with the axis of the body. The whole of the spongy portion is then rectilinear.

The prostatic and membranous portions are situated in the same line with each other, and form the second curve of the urethra when the penis is flaccid, the only one when the penis is straightened or erect, commencing at the bulb, that is to say, at the point where the spongy and membranous portions meet, and forming an angle of about an hundred degrees, obtuse, and open above. The first curve is temporary, the second is permanent, yet can be readily effaced, as is proved when the straight catheter is introduced.

The distance from the first curve to the inferior border of the symphysis pubis, is about six lines. The distance from the symphysis to the second curve, which lies just behind the first, is about eight lines; the neck of the bladder corresponds to the middle portion of the posterior aspect of the symphysis, and is about one inch from the second curve.

Calibre.—The calibre of the urethral canal varies in individuals; is increased during the discharge of urine, and particularly when foreign bodies are introduced. It may be dilated, without rupture, to the diameter of four lines or four lines and a half. The prostatic portion is large and very dilatable; the membranous portion is extensible, but is rendered temporarily narrow by the contraction of the muscles which surround it. The spongy portion is large and dilatable; it is

frequently supposed to be narrower at the point where the suspensory ligament is inserted, which is sometimes owing to the clumsy manipulation of the person introducing the catheter, when the latter has reached the bulb; in some cases, however, there is at this point a real obstacle to the introduction of the instrument. There is sometimes an enlargement at the fossa navicularis, and a curve with its concavity looking downwards at the point where the glans unites with the corpus cavernosum. The meatus may, in certain cases, be very narrow, it may open at a greater or less distance from the frænum, or, in rare cases, by one or more orifices, etc. (Plate 77, fig. 9 *bis.*)

Structure and relations.—We will examine first the mucous membrane, then the external tunic, and lastly those parts which serve as coats to the canal. 1st, The mucous membrane is thin, extensible, and deeper colored as it approaches the meatus, where it is continuous with the less humid mucous membrane which covers the glans, and is of a bright rose colour; at the other extremity of the urethra, it is continuous with the mucous membrane which lines the bladder. In the spongy portion of the urethra it adheres strongly to the subjacent layer, but less so in the membranous and prostatic portions. It forms longitudinal folds throughout its whole length, which take the shape of a deep coloured rosette at the neck of the bladder. At each of its extremities there is a median projection, in the form of a raphé,—the one in the inferior wall, in the fossa navicularis, being slightly marked and not always present, the other in the same wall at the prostatic portion being well marked, to which the name of *verumontanum* has been given. This last projection reaches to the neck of the bladder, where it is terminated by an enlargement which corresponds to what has been called the middle lobe of the prostate, enclosing within it a small cavity named the *utriculus;* the ejaculatory ducts open on each side of this cavity, and the excreting ducts of the prostate gland have also their orifices upon each side of the verumontanum. These latter ducts may, in some cases, open at any point of the diameter of the canal, although their orifices are usually in its inferior walls. Here and there, along the floor of the urethra, are also found the openings of the lacunæ of the urethra, or the glands of Littre and Morgagni, and finally, in the membranous portion, the orifices of the excretory ducts of Cowper's glands. The orifices of the ejaculatory and prostatic ducts, and of the lacunæ of the urethra, may sometimes catch the extremity of very delicate bougies; but this

happens much more rarely than is generally supposed. (Plate 77, fig. 1, *a*.)

2d. The external layer which forms one of the coats of the urethra, is usually, but very improperly, called the fibrous layer; its character varies in different parts of the urethra, but, as a general rule, it is very elastic and retracts a great deal when divided across. The retraction or shortening of the urethra depends upon the degree of adhesion which this layer has with the adjacent parts, and it accordingly varies in different places,—an important fact in connection with amputation of the penis.

We will proceed to the examination of this external tunic in the three portions of the canal. In the spongy portion, it is essentially vascular and erectile, which conditions are exceedingly well marked at both extremities of this portion of the urethra, the glans in front, and the bulb behind, being only considerable enlargements of the erectile layer; this peculiar structure seems to predispose the spongy portion of the urethra, in a singular degree, to inflammation of an obstinate character, and to organic strictures which are a consequence of this inflammation. (Mercier.) Outside of the erectile layer we find the fibrous tunic,—the tendinous envelope of the penis, which fixes the urethra firmly to the corpus cavernosum, after which comes the skin, which is separated from this tendinous envelope by very loose areolar tissue.

Farther back, the fibrous expansions of the erector penis, and the accelerator urinæ, are intimately united to the bulb, and to the adjacent part of the spongy portion; the superficial aponeurosis of the perineum covers the external surface of these muscles. At this point the urethra is covered by the scrotum.

3d. In the membranous portion of the urethra, the external tunic has really the appearance of a white, fibrous, resistent, and very elastic membrane; it produces a slight narrowing of the canal at the bulb, which Amussat calls the *neck of the bulb;* in front of the latter there is a slight enlargement of the canal, in which the end of the catheter is caught just before it enters the membranous portion. Around this part of the canal there is a muscular fold which has been called the sphincter of the urethra, which is formed by fibres of the transversus perinei muscles, and the loops which they form surround the urethra like a button hole; these muscular fibres are the cause of the spasmodic strictures which are found in this locality, where organic strict-

ures are rarely met with. Mercier thinks that these are not real strictures which are found at this point, but rather deviations of the canal; he asserts, that the membranous portion of the urethra is surrounded with loops of muscular fibres arranged in planes, which, embracing both the superior and inferior aspects of the urethra, go from thence to be inserted into the ischium of each side. These muscles, which are described by Guthrie, flatten the canal transversely. Other fibres, described by Wilson, which have been wrongly considered by some as the anterior portion of the levator ani muscles, arise from either side of the symphysis pubis, and are inserted into the walls of the rectum; the central portion of these muscles lie in contact with the sides and inferior portions of the prostate gland and the neck of the bladder, surrounding them like a sling. These fibres when they contract, carry the prostate and neck of the bladder upwards and forwards towards the symphysis. The simultaneous contraction of Guthrie's and Wilson's muscles would bend the urethra at a right angle. The membranous portion is in immediate relation with the veins of Santorini, and cellular tissue, which separates it from the symphysis. Behind, it is almost entirely covered by the bulb; in fact, it belongs to the region of the perineum, and lies between the deep and middle aponeurosis.

4th. The fibrous tunic is very thin in the prostatic portion of the urethra; the firm and resistent tissue of the gland takes its place. Some authors assert that a thin layer of muscular fibres surrounding the neck of the bladder, are interposed between the gland and the urethra.

The deviations, and malformations, which the canal so often presents in old men, are almost always pathological; while the development and minute structure of the urethra exhibit interesting peculiarities, which are described at length in special treatises upon this subject.*

* The Lettsomian lectures of Mr. Henry Hancock, of the Charing Cross Hospital, London, "on the Anatomy and Physiology of the Male Urethra, and on the Pathology of Strictures of that Canal," London, 1852, is one of the best monographs on this subject recently published.—Ed.

INTRODUCTION OF THE CATHETER INTO THE URETHRA.

Catheterism of the urethra consists in introducing an instrument into the bladder, either to evacuate its contents, to ascertain the presence of foreign bodies, or to aid in making a diagnosis, and also to serve as a guide in the performance of certain surgical operations. This compendious definition will give an idea of the importance of this operation, and of the frequent necessity of its performance. It will be understood that the introduction of either straight or curved instruments, which are to be used to dilate, cauterize, scarify, incise, &c., &c., the urethra, the prostate gland, the neck of the bladder, or for the extraction of foreign bodies, the operations of lithotomy, lithotrity, &c., must be performed according to the rules which we are about to lay down for the introduction of a simple catheter into the bladder.

Catheterism of the urethra differs in males and females, in children, and in old men, in the healthy and in the morbid state. We shall speak elsewhere of catheterism in the female, but we are compelled to refer to special treatises for directions for the performance of this operation in various diseases. The instrumental apparatus consists of two very different kinds of instruments: 1st, curved instruments; 2d, straight instruments. The first may have a fixed curve, such, for instance, as the ordinary case catheters, metallic catheters made of steel, pewter, silver, &c., or their curve may be changed at the option of the individual; the latter are made of gum elastic, which are rendered firm for the time being by the insertion of a piece of iron wire. Catheters have been made of gum-elastic, of linen cloth saturated with wax, gutta percha, ivory &c. (See Instruments, plate XIX., Fig. 4, 5, 6, 7, 8).

Every person is acquainted with the curve of the ordinary catheter, and the proportion between the part which is straight, and that which is curved. If the patient be young, the curve should be greater; but for old men, on the contrary, for diseases of the prostate gland and the neck of the bladder, or for exploring the latter organ, Mercier advises the surgeon to use catheters which are bent almost at a right angle, about two-thirds of an inch, or an inch, from the extremity. (See Instruments, plate XX., Fig. 25, and plate 78, Fig. 2 and 2 bis.) Instruments before they are introduced should be slightly warmed and oiled.

Catheterism with curved instruments.—This consists of two methods, the ordinary method and the trick method.

1st. *The ordinary method.*—(Plate 76, Fig. 2, 3 and 4).

Position of the patient.—The patient lies down upon his back on the left border of a bed or sofa, with the head inclined upon the body, the legs raised, the thighs separated and flexed upon the pelvis; a large broad basin is placed between the thighs, below the penis, where it is held by the patient, or an assistant.

Position of the surgeon.—Generally on the left side for convenience of using the right hand; if the surgeon stands upon the right side, he will be obliged to introduce the instrument with the left hand, which, in simple cases, is not difficult. The surgeon takes the penis between the first fingers of the left hand, the thumb being upon its dorsal aspect on a level with the corona glandis, the first finger opposite the frænum and the second an inch lower down; without compressing the penis, he raises it up towards the abdomen in such a direction that the curve in the spongy portion is reversed, its concavity looking upwards. (See Anatomy of the urethra, and plate 76, Fig. 2 and 3.)

Traction upon the penis will stretch it about half an inch or thereabouts, but more than this is not advisable.

The orifice of the urethra is now uncovered, and if possible, the prepuce is drawn completely back.

The penis may be held in the direction of the median line of the anterior wall of the abdomen, for the purpose of introducing the catheter; but if the abdomen projects too much, or the curve of the instrument be very great, it is better carried towards the left side. It is preferable, perhaps, in all cases, to turn the penis towards the left groin. The surgeon takes hold of the catheter, a little below its open extremity, with the thumb and two first fingers of the right hand, the thumb being above and the fingers below, holding it always lightly, so as to preserve the necessary delicacy of touch whilst passing the instrument.

The axis of the catheter corresponds now very nearly with Poupart's ligament, its convexity looking upwards. Having been inserted into the meatus, the instrument is introduced into the urethra with as much gentleness and dexterity as possible; too much haste sometimes produces acute pain, and a spasm of the passage. The left hand retains the penis as at the commencement, until the point of the

catheter reaches the symphysis, when the points of the fingers are applied to the convex portion of the instrument to prevent it from descending too far. The surgeon now carries the catheter in a direction parallel with the median line, and slides its point, which looks directly backward, below the symphysis, and its concave portion being thus brought fairly beneath the pubic arch, its free extremity is gently carried away from the abdomen by making it describe the arc of a circle, a finger of the right hand being placed upon the open extremity of the instrument, so as to control the escape of urine. When there is no deviation, stricture, or spasm of the urethra, the catheter, if introduced as we have described, in the normal course of the canal and its curves, readily passes into the bladder, without exerting the slightest amount of force; this, in fact, is rarely required in any case. When the point of the instrument passes through the neck of the bladder, which is usually recognized by the peculiar sensation which it gives, the urine rushes forcibly to the free extremity of the catheter, which is stopped by the fore finger, and then the surgeon bends it down by a lever-like movement, so that the liquid will run into the vessel ready to receive it. (Plate 76, Fig. 4.)

When the catheter is being passed along the urethra, there is a natural inclination to draw the penis forward upon the instrument, and some surgeons have even advised this to be done; Malgaigne however considers it as useless, the catheter being introduced more easily when the penis is left entirely to itself. Traction upon the penis, however, is always performed when the straight catheter is used.

2d *Method.—The "tour de maître."*—This brilliant and celebrated method was very much in use by the surgeons of the last century; and it sometimes succeeds when the former has failed. It seems to be appropriate when the abdomen is very large, and in some other cases the nature of which is not well understood. It is performed in the following manner:—

Position of the patient.—He may be either sitting, standing, or lying down, the latter being preferable. The pelvis rests on the edge of the bed, the thighs and legs being flexed and separated as described above.

Position of the surgeon.—Either on the right side, or, better still, between the knees of the patient. The penis is taken between the thumb and fingers, either above and below or by the sides, the organ

being very slightly raised up towards the abdomen. The catheter is held in the right hand, its concavity looking downwards and backwards, and its point turned towards the perineum, in which position it is introduced into the urethra, and pushed directly backwards until it passes under the pubis and reaches the bulb. The surgeon now presses his fingers slightly upon the root of the penis to prevent the instrument from slipping back, and rotates the catheter from right to left, making its free extremity describe a semi-circle which brings it directly opposite the median line of the abdomen. This position of the instrument is similar to that of the second position in the ordinary method. If the surgeon in making the rotation presses lightly upon the open extremity of the instrument, it very readily passes into the bladder.

Malgaigne thus explains the success of this method: "The point of the catheter arrives exactly at the most depending portion of the urethra, when, in giving it the movement of rotation, it almost spontaneously makes its way along the ascending portion, which is the more readily effected as the penis is in a state of complete relaxation."

Flexible catheters rendered stiff by the insertion of a piece of wire, are introduced in the same way as those already described; a little more difficulty however is experienced. But when instruments have been frequently introduced, a flexible catheter, with or without curve, can be very easily passed in with slight pressure, especially if the instrument be large and very firm. The stylet seems to be useful only for the purpose of passing around the symphysis, it can therefore be withdrawn without trouble, or danger, without waiting until the catheter has been carried up to the neck of the bladder. As soon as the latter is fairly introduced into the membranous portion, the penis should be firmly grasped with the left hand, so as to retain the catheter in the urethra whilst the stylet is withdrawn.

According to Hey, the stylet can be firmly held, and the catheter alone pushed into the bladder, an operation which might suit some cases.

Introduction of straight catheters.—The anatomical description which we have given of the urethra, proves the possibility of performing this operation. The description of the latter by Amussat, has had a great influence upon the surgical treatment of the urinary passages, and especially upon lithotrity.

Position of the patient.—He may be lying down, sitting or standing,—the latter position being generally preferred. The thighs are separated, and the body slightly bent forward.

Position of the surgeon.—He places himself between the patient's legs, either standing upright, leaning forward, or with one knee upon the floor. The penis is taken with the left hand, and raised up until it forms a right angle with the axis of the body. The catheter is passed from before backwards, directly through the penis, beneath the suspensory ligament, until it reaches the sub-pubic portion, opposite to the bulb. Up to this point the instrument has followed the direction of the axis of the canal, and particularly of the inferior wall; but the surgeon now draws the penis forward upon the instrument, and at the same time depresses the free extremity of the latter, so that it traverses the fourth of a circle, which raises the point so that it passes through the membranous and prostatic portions (plate 78, fig. 1); it is frequently necessary to depress the free extremity of the instrument strongly, and to keep its point in contact with the anterior wall of the canal, to avoid being arrested by the prostate gland, and the projection formed by the neck of the bladder. If not successful at the first attempt, the surgeon should partially withdraw the catheter, and perform the second step of the operation anew; the penis should never be put upon the stretch until the instrument has passed beyond the symphysis.

Obstacles to introducing the catheter.—Accidents which are liable to take place.—Means of remedying them.—The several manœuvres which we have described do not always succeed at the first attempt; the obstacles liable to be encountered, and the means of remedying them, ought, therefore, to be pointed out. We shall also designate the accidents which may take place in introducing the catheter, how to avoid them, and the precautions which should be taken in performing the operation anew, when the urethra has been already wounded.

The difficulties are of two kinds; they may depend upon an unskilful performance of the operation, or upon lesions, or deviations of the canal. In either of these cases false passages may be produced, and serious consequences follow.

Unskilful management.—The catheter may be caught, at the root of the glans, in a large lacuna, which is very common in the superior wall at this locality, particularly when the meatus opens very near the frænum; by keeping the point of the instrument in contact with the

inferior wall it is easily avoided. The instrument may be stopped at the suspensory ligament of the penis, at the point where the penal and sub-pubic portions meet; this may happen in consequence of the instrument having been kept too closely in contact with the superior wall of the urethra, or because the curve is too great, or the free extremity has been depressed too soon; if this be the case, the catheter must be partially withdrawn, and its point depressed slightly, when there will be no longer any difficulty experienced in carrying it on to the membranous portion. The "tour de maître," or bending the penis to one side, as already described, can sometimes be tried with beneficial results. A third obstacle is sometimes met with at the bulb,—at which point there is frequently a depression in the inferior wall, with the concavity looking forwards and upwards, which is sometimes of considerable depth; if, in following the inferior or posterior wall, the catheter is urged forwards, it may be suddenly stopped and perhaps perforate the bulb, or at least pass through the species of valve which stops it; when there is reason to suppose that such is the nature of the obstacle, the free extremity of the instrument must be depressed so that its point is brought in contact with the opposite wall, or in other words, as nearly as possible to the posterior surface of the symphysis pubis; two obstacles of the same nature, and which are, to a certain extent comparable, are met with a little farther on; 1st, The termination of the membranous portion, at the anterior border of the prostate gland; 2d, The neck of the bladder, where it forms a species of valve, sometimes of considerable size. The manœuvre described above easily remedies these difficulties, which can always be avoided by proceeding slowly, and keeping the point of the instrument in contact with the anterior wall. It is only by an accurate acquaintance with the length and direction of the urethra, that the surgeon can be aware of the exact place where the point of the catheter is stopped. This knowledge, therefore, is of the greatest importance; and when acquired, it will only be necessary, in the great majority of cases, to turn the catheter in this or that direction to bring it into the normal direction of the canal.

Lesions of the canal.—A great variety of obstacles to the introduction of the catheter must be included in this category, all of which have not the same importance. The instrument may be caught in one of the lacunæ of the urethra (plate 77, fig. 1, *a*), in the dilated orifice of the prostatic, or ejaculatory ducts, in the prostatic utriculus,

all of which are possible when very small bougies or catheters are used, but with instruments of the ordinary size, the occurrence of such accidents are exceedingly improbable, if not impossible. But when there is a narrowing of the canal, or when the enlargement of one, or more, lobes of the prostate gland completely changes its character and direction, the introduction of the catheter is by no means so easy as when the urethra is in its normal state; the same is true, when there is spasmodic contraction of the muscles surrounding the urethra, a description of which we have already given. The variety of such cases is so great, that no absolute rules for treatment can be given. Useful precepts will be found, however, in the article on *strictures.*

Perforation of the canal, which produces false passages, is one of the most serious accidents which are liable to happen in introducing the catheter. It is much more rare when the passage is normal, than when any of the lesions already enumerated exist; yet, even in the first condition, the unskilful use of instruments, or of unnecessary force, has sometimes produced it.

False passages may be produced by the perforation of a septum, existing either in the urethra itself, or at the neck of the bladder. The middle lobe of the prostate gland is not unfrequently perforated in this way (plate 77, fig. 1). In such cases, which are rarely serious, the instrument makes a kind of seton in the walls of the urethra, and then returns into the regular passage, and passes into the bladder. But, under other circumstances, the urethra is perforated and the catheter thrust into the adjacent parts, making a false passage, whose depth depends upon the force or perseverance with which the instrument has been urged forwards. Authors describe an infinite number of lesions of this character, as singular in their details as serious in their consequences.

False passages are frequently found just in front of the bulb, and very generally in the membranous portion; they are usually in the floor of the urethra, are sometimes numerous, and may be complicated by hemorrhage, infiltration of urine, etc., etc. An abundant discharge of blood, together with the deviation of the catheter from its normal direction, and the decided obstacle offered by the tissues to its farther introduction, are the principal signs by which the production of a false passage is recognised.

It may happen that false passages already exist when the surgeon

is called on to introduce the catheter; in such cases, his first duty is to ascertain the exact position of the perforation, and then, by carefully performing the operation, in the manner which we have already described, to endeavour to keep the instrument in contact with the wall of the passage, opposite to that in which the lesion is located. Large catheters rarely produce this accident, and may be used even when it has already taken place. When false passages exist, the introduction of the catheter requires the greatest delicacy, caution and tact, which are only acquired by long experience.

Plate LXXVII.

FALSE PASSAGES—STRICTURES OF THE URETHRA—URETHRORAPHY AND URETHROPLASTY—ENLARGEMENT OF THE MEATUS—FASTENING OF CATHETER.

Fig. 1. *Accidents which may happen in introducing the catheter.*—*a*, the point of a bougie caught in a lacuna of the urethra; *b*, another bougie, having been thrust through the mucous membrane, has been again brought into the normal passage; *c d*, catheters caught in old false passages in the middle lobe of the prostate gland, which, having healed, allowed the urine to flow through the natural passage,—being an accurate representation of a lesion which occurred in an old man; *e*, the urethral crest; *f*, the hypertrophied bladder.

Fig. 2. *The introduction of bougies into strictures.*—*a*, the meatus; *b*, the conical extremity of the bougie introduced into the stricture; *e*, the bulb of the urethra; *d*, the symphysis pubis; *c*, the prostate gland; *f*, the cavity of the bladder.

Fig. 3. *Cauterisation of the prostatic portion of the urethra with Lallemand's porte-caustique.*—*a*, the meatus; *b*, the membranous portion, into which the instrument, armed with caustic, has been passed; *c*, the prostate gland; *d*, the symphysis pubis; *e*, the bulb; *f*, the cavity of the bladder.

Fig. 4. *Cauterisation of the membranous portion of the urethra with the straight porte-caustique* (See Instruments, plate XIX., fig. 12).—*a*, the canula of the porte-caustique, already introduced into the urethra; *b*, the stylet, into a lateral depression of which the caustic is inserted, is thrust beyond the extremity of the canula; *c*, the prostate gland; *d*, the symphysis pubis, *e*, the bulb; *f*, the cavity of the bladder.

Fig. 5. *Incision of strictures of the urethra.*—*a*, the meatus; *b*, the conical point of the scarificator inserted into the membranous portion; *b''*, the enlargement of the scarificator about an inch from its point; *b'*, a blade protruded from the enlarged portion of the instrument, by

Fig. 1

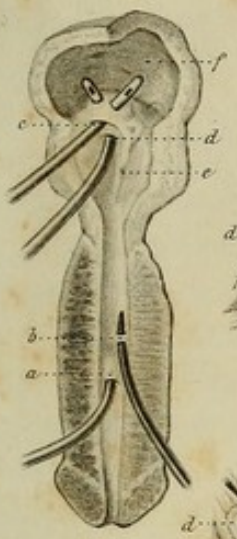


Fig. 4

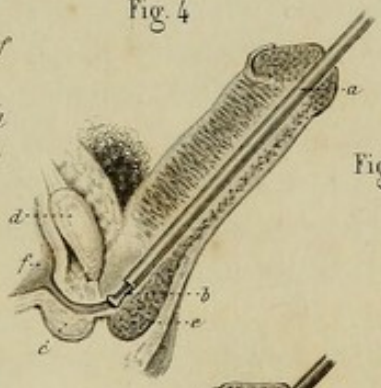


Fig. 3



Fig. 2



Fig. 5

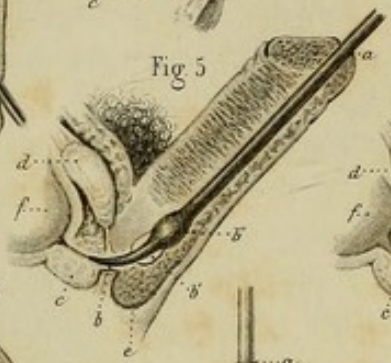


Fig 6



Fig 7

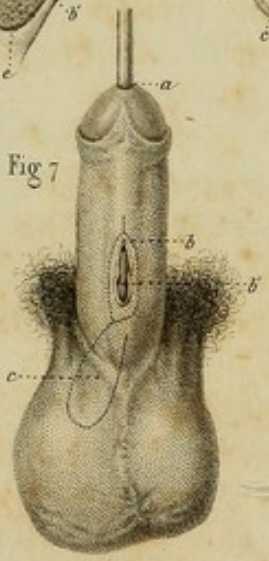
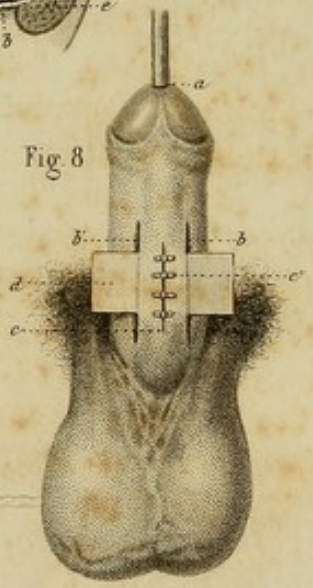


Fig 8



F. 9 bis



Fig. 9



Fig. 10



Léveillé del.

Davenne sc.

means of a stylet running through the canula of the instrument; *c*, the prostate gland; *d*, the symphysis; *e*, the bulb; *f*, the bladder.

Fig. 6. *Antero-posterior section of a strictured urethra.*—*a*, the meatus; *b'*, the stricture, behind which the canal is considerably dilated, while the portion extending from *a* to *b* is evidently contracted; *c*, the commencement of the membranous portion; *e*, the internal orifice of an antero-posterior fissure occurring in the floor of the spongy portion of the urethra.

Fig. 7. *Urethroplasty by the Indian method.*—*a*, a catheter introduced into the meatus; *b*, the same seen between the lips of the fistulous opening; *b*, the fistula in the inferior wall of the spongy portion of the urethra—(the loss of substance and the thinness of the lips of the wound are here shown,—the dotted line indicates the extent to which the skin must be pared away); *c*, the lateral, autoplastic flap cut from the integuments at the root of the penis and scrotum. This flap should be a third larger than the wound which it is intended to cover.

Fig. 8. *Urethroraphy with lateral incisions.*—*a*, a catheter introduced into the urethra; *c*, the fistula, whose edges, having been first pared off, are brought together by points of suture *c'*, inserted three or four lines from each other; *b*, *b'*, lateral parallel incisions about the third of an inch from each other, and made a little longer than the fistula; *d*, foreign bodies inserted between the lips of the incisions *b b'*, to prevent their union by the first intention.

Fig. 9. *Incision of the meatus urinarius.*—*b*, a very sharp-pointed sickle-shaped bistoury has been inserted into the meatus at *b'*, and brought out, by transfixion, at *a*; *b,''* exhibits the point of the instrument, covered with a small ball of wax. This method is applicable to hypospadias in the first degree.

Fig. 9. *bis.*—A urethra having two very narrow orifices, *a* and *a'*, lying one above the other. The preceding method of operating is applicable to this condition of the urethra.

Fig. 10. Method of fastening a catheter for permanent retention in the urethra. A thread attached to the catheter is also carried around the root of the glans.

STRICTURES OF THE URETHRA.

A stricture of the urethra consists of a diminution of the calibre of the canal due to a lesion of its walls.

There are several classes of strictures which are arranged according to the causes which produce them. Most authors recognise three classes:

1st. *Inflammatory strictures.*—These are produced whenever an inflammation of the mucous membrane of the urethra occasions a swelling of this membrane so considerable as to obstruct the free passage of urine.

2d. *Spasmodic strictures.*—Although frequently denied, yet lesions of this character really take place, but they would more properly be called spasms of the urethra. Mercier has thoroughly studied their character and etiology, and asserts, that they depend less upon a diminution of the calibre of the urethra than upon a deviation of the canal, whose course is modified by the spasmodic contractions of Wilson's and Guthrie's muscles.

3d. *Organic strictures.*—These are the most common as well as the most obstinate forms of stricture; they usually follow chronic gonorrhœa, or traumatic lesions of the urethra. Some authors admit the existence of this class of strictures only; and, in fact, they are generally complicated by a spasm and inflammation. We are willing to admit this view of the subject to a certain extent, and shall confine ourselves in a great measure, in this article, to the examination of this variety of strictures.

4th. The canal of the urethra may be turned aside, effaced, or contracted by various kinds of growths, which may be developed in its walls, or in the adjacent parts. These lesions, which are not always easily distinguished from strictures, properly so-called, ought not to be confounded in the same class. Ancient authors frequently speak of fleshy growths, vegetations, and polypi of the urethra, as causes of stricture. Such growths sometimes exist, but they are very rare. Usually there is but one stricture, but we may find two, three, and even more; they sometimes present themselves in the form of cicatrices of a greater or less extent, the result of traumatic lesions, which materially diminish the extensibility of the canal, and at others, as projections and indurations, which are generally classed under three principal heads: 1st. The *simple septum*, of a whitish color, slightly

prominent, transverse, occupying more or less of the circumference of the canal; 2d, As *valves*, forming transverse septa varying in extent and thickness, with an opening whose size depends upon these circumstances, and also upon the position of the stricture; 3d, As a swelling, a *cylindrical induration*, from a line to an inch, and even more, in length; this latter variety usually consisting of several strictures lying very close to each other. All of these varieties are more perfectly developed in the inferior wall of the canal.

The diameter of the urethra, at the point of stricture, varies materially; in some cases it is but slightly diminished, while in others, the greatest difficulty is experienced in passing the minutest bougie through it: whatever may be said to the contrary, there is no doubt but that the urethra is sometimes completely obliterated.

The narrowness of the stricture generally depends upon the length of time which it has existed: this cannot, however, be laid down as an absolute rule. The difficulty experienced in passing water is not always in proportion with the narrowness of the stricture.

The tissue of which the stricture consists rarely presents the usual characteristics of mucous membrane, but varies in its consistence, to represent which, the names of fibrous, callous, indurated, and other titles have been employed. Reybard asserts that two fundamental properties are always present in this abnormal tissue, which explain most of the phenomena of this disease; these are, 1st, The slow, insensible, but continuous and invincible *contractility* of the tissue, which explains the incessant progress of the disease, and its relapse after dilatation; 2d, Its *elasticity*. The yielding of strictures depends upon this latter quality; they are dilated by means of instruments, but they almost immediately return to their former condition after these are removed.

When strictures are the result of wounds, they may be found at any point of the urethra, but generally in front of the scrotum, while those which are the result of gonorrhœa are usually situated farther back, in the vicinity of the bulb, just anterior to the membranous portion. According to Mercier, the structure of the whole extent of the spongy portion predisposes it to the lesion of which we are treating. In the membranous portion we find that species of stricture, variable in its duration, which depends upon the spasmodic action of the muscles, which form a species of sphincter around this part of the canal.

The existence of strictures in the prostatic portion is very problematical; their presence has been asserted after inexact measurements of the urethra, or rather because strictures have been confounded with certain affections of the prostate gland, or the neck of the bladder.

The surgical treatment of strictures consists of preliminary explorations, and then of such palliative, or curative, operations as may be deemed advisable, and of proper attention after the performance of such operations.

Preliminary operations.—The object of these is to ascertain the number, situation, form and calibre of the strictures. To speak properly, these operations go to make up the diagnosis, and are allied to catheterism only in consequence of the similarity in the operative manipulations which they require. The introduction of the ordinary, or of metallic, catheters of different sizes, or of bougies which are filiform, conical, or furnished with a bulbous extremity, will usually supply the surgeon with sufficient information upon which to base a treatment by simple dilatation; but, if he wishes to have recourse to cauterization, incision, or other operations of a similar nature, it is necessary for him to inform himself beforehand, as much as possible, of the limits and extent of the disease.

The exact distance of the seat of stricture from the orifice of the urethra is measured by means of a metallic catheter, upon whose anterior part the divisions of a foot measure are distinctly traced; with such an instrument it is easy to discover the exact locality of the disease, when the penis is not put upon the stretch. An ordinary catheter, either curved or straight, can be made to answer the purpose.

It is sometimes important to know the situation of the opening into the stricture, whether it is central, or close to the circumference, and if it be nearer to the upper or lower wall of the urethera, etc. Ducamp invented an *exploring catheter* for this purpose, but it is but little used at present.

A common elastic catheter, open at both ends, is filled with knotted strands of silk, which have been dipped into melted wax and allowed to cool. The waxed silk, projecting to a trifling distance from one end of the instrument, is farther besmeared with a mixture of yellow wax, lead plaster, resin and pitch, and moulded so as to form a conical termination for the catheter.

Thus prepared, the exploring catheter is introduced into the urethra, as far as the stricture. After giving the plastic mass time to soften,

the instrument is pressed upon the stricture, when the wax moulds itself upon all the convolutions of the latter, and even enters its opening; when the mould is fairly taken, the catheter is cautiously withdrawn, all movements of rotation being carefully avoided; by this means, the surgeon is able to ascertain the form of the anterior aspect of the structure, and also the precise locality of its opening.

The straight exploring catheter readily accommodates itself to the coarctations of the anterior portion of the urethra; but if it be necessary to go deeper in, the surgeon must use a curved catheter constructed on the same principles, or introduce a curved stylet into the straight catheter. To discover the length of the stricture, Ducamp used a very fine gum bougie which would pass easily through it; around this he wound a silk cord, thickly coated with wax. After passing the instrument through the stricture, he allowed it to remain for some time in the urethra. The wax acted as a mould, and the entire length of the stricture, or strictures, was impressed upon it.

There is frequently some difficulty in introducing this plastic bougie into the opening of the stricture, particularly when the latter is situated a little upon one side, that is to say, when it does not correspond with the axis of the canal. In such cases a conductor is used, which consists of an ordinary catheter of very large size, and open at both ends. The conductor being introduced as far as the stricture, the exploring bougie is passed through its interior down to the same point. If the opening of the stricture be central, the bougie passes into it directly; but if the opening is to one side, the extremity of the conductor is so modified, that its orifice, instead of corresponding to the axis of the canal, opens toward some part of the circumference. The conductor, modified in this way, is then carried down to the stricture, so that its orifice corresponds exactly with the opening into the stricture, when the bougie is easily passed into the latter. The idea of passing a bougie through a conductor is far from being modern, not being original, even with Ducamp; yet, there are modern authors who exhibit a determination to appropriate the discovery to themselves. The incomplete results furnished by this method stimulated Ducamp to invent another instrument for measuring strictures, both before and behind. This instrument consists: 1st, Of a large canula, terminated by a much smaller metallic cylindrical pipe of some six lines in length,t o whose free extremity two little moveable wings were attached, which could be pushed out or drawn in by means of a stylet

concealed in the canula. This instrument was introduced into the urethra, the metallic pipe passed through the stricture, the little rings forced out by pressing upon the stylet; and by moving these backwards and forwards, the length of the stricture ascertained. This idea has been appropriated in the construction of many kinds of urethral scarificators.

Segala's method.—A very large gum-elastic conductor is used, which is graduated, so that the exact depth of the stricture can be ascertained; a small probe-pointed silver stylet, which can be readily introduced into and carried through the stricture, is contained within it. By drawing this stylet very gently from behind forwards, the knob upon its end comes in contact with the stricture, and the stylet itself being also graduated, the length of the contracted portion of the urethra is ascertained by noticing the distance which the stylet has passed through the conductor.

Amussat's method.—A straight, graduated canula, of about seven inches in length, with a canal traversing it from end to end, but not corresponding with its axis, contains a stylet, terminated by a disk or button, which accurately covers the end of the canula, and represents the blunt extremity of an ordinary catheter. The other extremity of the stylet is so shaped that a rotatory movement can be given to it, this being the only movement of which it is capable. The instrument being introduced into the urethra, a semi-rotation is given to the stylet, which displaces the disk, and makes it project beyond the canula. With this disk, we can scrape (so to speak) the urethra backwards and forwards, and all around, and ascertain, in this way, the existence of the slightest septum, or inequality. According to the author, this disk never meets with any obstruction in a healthy urethra.

Straight exploring instruments are well adapted to the straight portions of the urethra; but beyond its spongy portion the ordinary curve is desirable. These means of exploration are in general approximative, and we will therefore pass over the objections which have been made against them, as well as the modifications which they have undergone. Neither will we dwell upon the contrivance consisting of bougies arranged in bundles, nor upon the various instruments used by Lallemand, Blanchard, and others. Each of these surgeons has his own peculiar way of examining strictures. A long time is always required to obtain an exact knowledge of their nature

and shape, and the great majority of surgeons are not in the habit of using any peculiar instruments for this purpose.

Bougies, with a bulb upon the extremity, are frequently of great service; they are readily passed from before backwards through the stricture, but, when withdrawn, indicate the extent of the obstacle, its resistance and the elasticity of the abnormal tissue.

The existence of several strictures is rarely recognised until that nearest the meatus is dilated. In the two anterior thirds of the urethra the approximative length of the stricture can sometimes be ascertained by the finger, applied externally.

If the stricture be too narrow to allow the introduction of exploring instruments, its dilatation should be attempted in the ordinary way.

The operations, properly so called, which are performed for strictures of the urethra, are very numerous, and are classed under various methods, which are also subjected to various modifications.

The different methods may be grouped under two general heads: 1st, Where an effort is made to overcome the elasticity and resistance of the abnormal tissue, 1st, by mechanical means; 2d, by modifying its vitality. In the majority of cases, the first object alone is attained, it being rarely possible to restore the mucous membrane again to the condition of a healthy tissue; we therefore believe the radical cure of strictures to be extremely rare; the tissue of which they consist belonging to the inodular variety, and partaking of all of its irritable and contractile properties.

Dilatation, forced injections, and perhaps electricity, must be classed in this first category.

2d. Here, the design is to enlarge the stricture mechanically, by a solution of continuity. The methods employed for this purpose have something in common with dilatation, so far as the object is merely to enlarge the strictured opening by means of one or more *simple incisions*, whether they are limited to the tissue of the stricture itself, or carried beyond it; under this head comes Reybard's operation of urethrotomy and the perineal section. In other cases, the cutting instrument is only brought in contact with the morbid tissue for the purpose of making scarifications upon it, supposed to lead to absorption. If the division be made with blunt instruments, it should be called laceration. *Perreve's method.* The object of other methods, again, is not to dilate, divide, or separate the morbid tissue, but rather to destroy it. These are cauterisation, perforation, and exsection. It is

very difficult to classify accurately all these operations, whose action is complex and frequently combined. The most marked distinction between them, however, consists in the fact, that, in some of them, the object is to overcome the obstacle by stretching, while the purpose of others is to destroy it by violence. The first produce no injury, no solution of continuity, while the second give rise to wounds followed by cicatrices which complicate the original disease.

With these general ideas we will dispense with the further discussion of the value of these various methods and processes; they will serve as guides to the surgeon in the choice which he ought to make, and inform him of the advantages which he may hope to obtain, as well as the inconveniences which are liable to result.

For the successful employment of the majority of these methods, an instrument must be carried through, or at least introduced into, the stricture. If the bougie cannot be introduced at the first attempt, it may, as Dupuytren has advised, be fastened so that its point will press lightly upon the obstacle for a few hours, when it is by no means rare to see it enter without further difficulty.

Bougies of different sizes ought always to be tried, as the smallest instruments do not always enter the most readily. Bougies with an oval-shaped enlargement upon them, are sometimes very useful. Special means for overcoming the difficulty which is first experienced, are by no means wanting, and for this purpose, the operations and instruments devised by Amussat, Beniqué, Maisonneuve, or Blanchard, may be found useful; we would call particular attention to the bougies arranged in bundles, and the conducting bougies known by the name of Ducamp's instrument, etc. The following is the method employed by Leroy d'Etiolles.

Twisted bougies.—The principal obstacle to the passage of ordinary bougies through some strictures, depends upon the point of the instrument, which, instead of entering their opening, comes continually in contact with their anterior surface; to remedy this, take a fine bougie and give its extremity a spiral shape, by winding it for two or three minutes around a large pin, and then by introducing it into the urethra as far as the stricture, and rotating it slightly upon its axis, it will generally pass at once into the opening; when it does not do so readily, it must be partially withdrawn and again presented to the stricture, while the rotation is being performed.

Dilatation.—This may be considered as the fundamental operation

in the cure of strictures, it being at the same time palliative and curative. The canal must always be dilated before introducing instruments for the purpose of cauterising, scarifying, or incising the stricture; it is therefore associated with all other operative procedures employed for the cure of stricture; whether their object is to obtain temporary relief, or to prevent relapses, it is indispensable to all of them.

Dilatation is associated with a large number of secondary processes, which vary according to the kinds of instruments employed, the length of time they are allowed to remain, and the degree of force used in their introduction; dilatation being progressive or immediate, continuous or intermittent.

Progressive dilatation.—This is usually performed with gum, or wax bougies, those made of catgut, softened ivory, etc. Medicated bougies, those impregnated with alum for instance, act in the same way as ordinary instruments, and have none of those special virtues attributed to them by certain surgeons.

The bougie being well oiled, is introduced into the canal (the urethral curves being straightened, as in ordinary catheterism), and carried slowly and cautiously forward to the stricture, into which, in the majority of cases, it will enter without difficulty, when the stricture is not very narrow, or if instruments have already been passed through it; if difficulty be experienced in introducing the bougie, it may be partially withdrawn, and rotating it, it may again be carried down to the obstacle. Its entrance will be recognised when it is tightly grasped at the strictured point. To carry it into the bladder, it must be introduced some seven or eight inches, care being taken to avoid irritating, or injuring the walls of this organ. After an interval, the duration of which varies according to circumstances, a bougie of larger size is substituted for the first, and this gradual increase of size is continued until the canal has arrived at its proper dimensions. It was formerly the practice to leave the instrument in the stricture by fastening it externally, and only changing it every three or four days. This practice was productive of serious inconveniences, such as incrustation of the bougies, by the salts of the urine, irritation of the bladder, inflammation, and perforation of the urethra, etc., so much so that it is now only employed in exceptional cases, such as when the stricture is very small, or where there is great difficulty in finding the true passage. Instead of introducing instruments to be permanently

retained, *intermittent dilatation*, or the introduction of instruments at *stated periods*, is preferred, which rarely causes any serious symptoms, and does not prevent the patient from pursuing his usual avocations. The following method is presented as a type:

Benique's method.—Some sixty bougies, or pewter catheters, are used, graduated in such a way that they vary from half a line to five lines in diameter. At the first operation, the surgeon introduces into the stricture the largest possible instrument—which is immediately withdrawn, and the one next largest inserted in its place; a third instrument is then introduced in place of the second, and thus several instruments are frequently inserted, one after the other, at the first operation; if the obstacle yields easily, the surgeon may skip one or more bougies. The operation should only last a few minutes, and after a short interval of rest, the patient may be allowed to depart. On the next day, or the day after, the operation is again performed by introducing the largest instrument passed on the previous occasion, or, if this be impossible, the next largest which can be introduced, and in this way the surgeon is frequently enabled, in the course of a few days, to dilate the urethra to its original dimensions. This result, however, is rare when the strictures are fibrous and of long standing.

Graduated metallic catheters are not indispensable; a series of bougies, gradually increasing in size, can be made to answer the same purpose.

Temporary dilatation.—In indurated strictures, a bougie is introduced, which is allowed to remain for eight or ten minutes, when it is withdrawn and replaced by a second, and even a third, if considered advisable; the last is allowed to remain in for one or two hours, at the expiration of which the patient himself withdraws it; if no irritation follow, the same process is repeated again the next day. A single bougie may be made to answer the same purpose, when it is conical at its point, and inserted with care and skill; it acts in such cases like a wedge, and takes the place of a long series of dilating instruments.

The extremities of catgut bougies, which are very hard, should be thoroughly polished. Malgaigne recommends that the ends of gelatine bougies be softened in warm water, to avoid wounding the urethra.

If the surgeon employs instruments which are to be permanently retained, he should exchange the bougie for a catheter, whose free

extremity is stopped by a plug which the patient can withdraw when he wishes to urinate.

A great variety of more complicated instruments have been used at different times to dilate the urethra, but with no great success; such as air dilators (Arnot, Ducamp), double branched forceps, moveable oval bodies attached to a conductor, etc.

Forced dilatation.—Mayor's method.—Instead of proceeding slowly, and proportioning the size of the bougies to the calibre and resistance of the stricture, rapid and instantaneous dilatation has been recommended.

Mayor gives the following as his reason for preferring this method: "The more firm and resisting the stricture, the greater are the difficulties in introducing an instrument into the urethra, and on this account a large catheter is much the most useful." He uses six pewter catheters, the smallest being two lines in diameter, and the largest four lines and a half. Commencing with the smallest, he introduces it at once, in the same way as an ordinary catheter. Having reached the stricture, he pushes the instrument forward with a certain amount of force, believing that the danger of lacerating the urethra diminishes, as the size of the instrument is increased. If the instrument passes through the stricture, the next larger is used, and so on until the whole six have been introduced, by which time the dilatation is considered complete.

The advantages of this method have been exaggerated by the author, and depreciated by other surgeons. It is painful, frequently fails, and is not free from danger; but it is sustained by an incontestible fact, that it is easier to introduce a medium sized catheter, than a fine bougie. Mayor's method may be advantageously employed in cases where the tissue of the stricture is very elastic, when there are spasms of the urethra, etc. It is very probable that occasionally it overcomes a stricture by producing a certain amount of laceration, a species of slitting up of the constricted part.

Perreve's method.—We include Perreve's methods under the head of forced dilatation, because the stricture must be pervious, and even well opened, before using his dilating instruments, which effect their purpose more by lacerating the stricture than by taking advantage of its elasticity.

Perreve uses two instruments; the first is shown in Instruments, plate XX., fig. 28, and is called the lateral dilator; the second consists

of two pieces of steel, lying side by side, and looking like a catheter when united; they are articulated at their vesical extremity, and may be separated at their opposite end to a greater or less extent, by means of a conical stylet which slides in grooves cut in the surfaces which lie in contact.

When this instrument has been carried a little distance beyond the stricture, the branches are separated by the dilating stylet, which acts like a wedge, and opens the dilator rapidly and irresistibly. The urethra, especially the stricture, is forcibly dilated. This method is very expeditious, the normal calibre of the canal being established at the first operation. But it is not free from danger, a case of death having been attributed to its employment, from extensive laceration of the urethra.

Scarifications—Incisions.—In this operation the knife is used to enlarge the stricture, the somewhat hypothetical hope being also entertained that resolution of the morbid tissue will be effected by the incisions. The enlargement of the urethra is effected by making one or more simultaneous or successive incisions, slighter according to the number, but never in any case carried through the morbid tissue, and wounding the adjacent parts. This method is best suited to valvular, or short strictures, producing as it does one or more trifling wounds, whose lips immediately separate and allow free passage to the urine, as well as the introduction of large bougies, which is indispensable to the success of the treatment.

The incisions are made by means of instruments which are called *urethrotomes*, or *urethral scarifiers*. Great numbers of them have been invented, some of which we have shown (Instruments, plate XX., figures 17 to 22). They are straight, or curved, according to the portion of the urethra which is intended to be incised; they operate from behind forward, and should always be first passed through the stricture; they are all constructed on very nearly the same principle, consisting of a canula containing a stylet, whose vesical extremity is armed with a knife concealed in the interior of the canula, while the instrument is being introduced; but which can be protruded by means of various mechanical contrivances, whenever the surgeon wishes to incise the stricture. These knives are sometimes lodged in the extremity of the canula, and sometimes in a groove, or lateral fenestra, situated near the vesical extremity. In curved urethrotomes, the knife generally issues from the convex part of the canula; the inferior

wall of the urethra being the one usually incised. Scarificators have generally but one blade; occasionally, however, they are provided with two, and even more. Leroy d'Etiolles uses an urethrotome similar to an urethral lithotrite, which divides a stricture like a pair of scissors. Some of these instruments operate from before backwards; that is to say, they divide the stricture by transfixion, but their use is generally condemned.

These instruments are used in the following way: the surgeon commences by dilating the strictures, having carefully ascertained their situation, distance from the meatus, and extent; the scarificator being closed, is introduced into the urethra, and the extremity of the canula is carried beyond the stricture, so that the blade, when pushed out, will lie behind it; the canula being firmly held in position, the knife is drawn from behind forwards through the stricture, far enough to divide the morbid tissue without injuring the sound portions of the urethra; the extent to which the knife shall be protruded is determined upon before performing the operation, and is proportioned to the narrowness of the stricture. When the surgeon is satisfied that the obstacle is divided, he can then proceed to incise some other part of the stricture, or postpone it until another time. The knife is then returned into the canula, and the instrument withdrawn from the urethra. The operation can be repeated several times during successive days, or a greater interval may be allowed to elapse.

Accidents resulting from scarification are usually but of little importance; hemorrhage has been occasionally the result, but it is in most cases easily controlled. This method is only palliative. The stricture returns when the little wounds heal; but the relapse can be prevented for a long time.

Urethrotomy.—This method, by slight incisions, which we are about to describe, is limited to the tissue of the stricture itself. Large incisions, however, have been employed, both from within outwards, and from without inwards.

Urethrotomy from within outwards.—Reybard recommends the surgeon to divide not only the stricture itself, but also the soft parts which support it as far as the skin; that is to say, the spongy tissue and the external fibrous tunic of the urethra. The incision is effected by means of an urethrotome, made upon the same principle as all other instruments of this kind, excepting in the extent of the blade, which is, in fact, very similar to the blade of a pen-knife, being nearly

an inch in length, and when entirely thrust out, forming almost a right angle with the shaft of the instrument. The canula is introduced into the urethra, and carried beyond the constricted point, when the blade is protruded, and divides it from behind forwards, whatever may be the form of the stricture. The incision should always be made in the lateral portions of the canal, because the walls are less thick in these parts, and there is no danger of wounding the arteries of the bulb, which lie below.

The incision is usually some two inches in length, and from two to three lines in depth; the fibrous tunic of the urethra must be divided to allow a proper separation of the lips of the wound; their immediate union is prevented, but the surgeon endeavours to make each of them heal by itself; the result of which is, that not only the original track of the canal is re-established, but there also forms between the separated and cicatrised lips of the incision, a certain amount of new tissue, which is smooth, glossy, but not contractile, and this, added to the walls of the urethra, increases their extent.

To separate the bleeding surfaces, Reybard uses as dilators various instruments, or large sized catheters, which he does not advise the surgeon to retain permanently; but rather recommends that they be introduced daily for about a month, and allowed to remain for a few minutes only in contact with the wound.

The accidents liable to follow urethrotomy, when performed in this way, are: hemorrhage, which is common, and sometimes accompanied by ecchymosis. Febrile attacks are also frequent, but the patient is liable to these when any operation is performed; inflammation sometimes takes place in the wound. Infiltration of urine, which the surgeon would naturally suppose that he had reason to fear, is a circumstance which very rarely happens, and is easily prevented.

Electricity.—The application of this agent to the cure of strictures is of recent date, and is due to M. Werteimber. Sufficient data have not as yet been obtained to warrant us in recommending its employment.

The object of the other methods which we have still to describe, is to destroy the morbid tissue, either gradually by the use of caustics, or mechanically, and at once, by cutting away a portion with the knife. The most celebrated of these methods is cauterisation, which has been held in high favor, but at present, is very much on the decline, and rarely employed, many surgeons entirely condemning its

use. It is performed in two ways, either laterally, or from before backwards. When lateral cauterisation is employed, the stricture must be dilatable, so that it will admit large sized instruments. In antero-posterior cauterisation, the caustic is applied to the anterior portion of the stricture, without being inserted into its orifice; this method is therefore applicable to two conditions, when the canal is permeable, and when it is almost obliterated.

A great variety of caustic holders have been invented for performing this operation. The great majority of them consist of a metallic canula open at its vesical extremity, or they have a lateral fenestra near this part; a stylet, to which the caustic is attached, slides backwards and forwards in the canula, or it is so arranged that by rotating it, the caustic, which is contained in a small lateral cavity, can be brought in contact with the stricture at the will of the surgeon (Instruments, plates XIX. and XX., fig. 10, 11, 12, 13, 14, 15 and 16). The caustic holders may be either straight, or curved; their size varies, according as they are intended to be carried through the stricture, or simply brought in contact with it; both the canula and stylet are generally graduated, so that the surgeon can see how far the caustic is introduced, and over what extent of surface it is carried.

The nitrate of silver is the caustic most in use; it must be melted, as in this condition the instrument is most conveniently charged with it.

Ducamp's method.—The caustic holder, being closed, is introduced into the urethra, and carried down to the stricture; the surgeon then protrudes the stylet, and the small cylinder of platina at its extremity enters the stricture, and the stylet is then rotated, so as to bring the caustic in contact with the part to which it is to be applied; if the stricture is central, the stylet is rotated several times upon its axis, so as to apply the caustic to all parts of the canal. The operation usually lasts about a minute. Scarcely more than a fifth of a grain of caustic is lost, therefore the eschar produced must of course be slight. Several applications of the caustic are required, usually at intervals of three days, the actual state of the stricture being previously examined on each occasion. A cure cannot be considered as effected until a catheter of three lines, or three lines and a-half, in diameter, can be easily introduced. All the other methods of cauterisation are so similar to this, as regards manipulation, that it will be unnecessary for us to describe them; the principal differences

between them arise from varieties in form of the instruments employed. A careful examination of the mechanism of the various caustic holders will suffice to give the surgeon a very good idea of the methods of Lallemand, Heurteloup, Amussat and others; we will, however, make a few remarks concerning the mode adopted by Leroy d'Etiolles.

When there is great difficulty experienced in introducing all kinds of bougies or catheters into the stricture, Leroy uses straight or curved instruments, according to the locality of the obstacle, which consists of a large sized canula open at both ends. Into this a flexible stylet is inserted, with a small cylinder of nitrate of silver, or of solidified Vienna paste, introduced into its extremity. The caustic is kept in contact with the stricture for two or three minutes; three or four applications, at intervals of four or five days, are usually sufficient to destroy the morbid tissue, and establish a passage large enough to allow the cure to be perfected by dilatation. Leroy and Vidal assert that the practice of this method has been attended with great success.

Cauterisation of strictures is a very unreliable remedy; in general it only affects a temporary amelioration, for the fact must not be lost sight of, that the stricture is made up of inodular tissue, whose contractile power is only destroyed for the time being by a partial destruction of its substance. The contraction of the morbid tissue is apt to return, and even to become more marked than before. These last remarks are also applicable to *excision* and *exsection*, which consist in removing the morbid tissue by means of a species of cutting punch. Excision is well-adapted to strictures of long standing, when they are situated in the straight portion of the urethra, and are permeable; but they always relapse in spite of dilatation and repeated scarifications.

In the long list of methods applicable to the treatment of urethral strictures, we place dilatation in the first position, being useful in all cases as a palliative, slow but sure, and also as a preliminary and supplementary operation. Whatever may have been the method adopted by which a stricture has been remedied, the surgeon should instruct his patient to introduce large sized bougies, as often as once in eight days, or even more frequently, in order to prevent too early a relapse.

Forced dilatation and small incisions are also palliative operations; and much more expeditious than simple dilatation; but these advantages are more than neutralized by the consequences, sometimes of a serious nature, which occasionally result from their employment.

Forced injections.—Forced catheterism.—External incision.—When instruments cannot be passed through the stricture by any of the methods which we have already described, and when the symptoms accompanying the retention of urine will admit of no more delay, there are still several extreme methods which can be employed, before performing the operation for puncturing the bladder.

These operations are: forced injections, forced catheterism and external incision.

Forced injections.—Amussat has attempted to bring them again into practice, basing his reasoning for their employment upon the fact, that the track of certain strictures considered impervious, though it may be exceedingly minute, still exists, but is blocked up by a strongly adhering mucous plug. He adopts the following method of performing the operation. A small gum-elastic catheter, open at both ends, is introduced into the urethra, and carried down to the stricture; a gum-elastic bottle, furnished with a fine canula, and completely filled with tepid water, is fastened to the external extremity of the catheter; the surgeon then stretches the penis well up on the catheter, and suddenly and firmly squeezing the bottle, forces with great energy a small stream directly upon the stricture. The gelatinous plug is thus forced back, and after one or more attempts, the patient is frequently able to pass a little urine.

If pressure with the hand is not energetic enough, the surgeon may place the bottle between his knees, and thus compress it much more vigorously.

This operation should be repeated, as it has sometimes proved successful, and there is little liability of any accident resulting from its employment; it is conceded that it may fail, which must necessarily be the case when there is complete obliteration of the urethra, a rare, but incontestible variety of disease, which does sometimes exist.

Forced catheterism.—It is proposed by this method to make an artificial passage by force through the tissue of the stricture. Boyer frequently performed this operation. It is effected by means of a conical metallic catheter, which is slightly curved, and very strong, so that it will not bend.

External incision.—This is an operation which is not performed for retention of urine alone, but also in many other circumstances. The method of performing it is somewhat similar to that of urethral litho-

tomy. Its object is to make a passage through the integuments to the urethra, and its indications are the following:

1st. When there is retention of urine depending upon the presence of a stricture, or other cause, which arrests its passage.

2d. When there is a foreign body impacted in the urethra which ought to be extracted.

3d. When it is considered desirable to establish a temporary passage for the discharge of the urine, after the performance of urethroplasty, or lithotomy above the pubis.

If the operation is performed upon a healthy urethra, as after the operation of lithotomy above the pubis, it is facilitated by the introduction of a grooved staff. In retention of urine, the urethra, distended by fluid, can sometimes be readily recognised, even without the introduction of a conductor; the same may be the case when foreign bodies are present. But such is not always the existing state of things, particularly when the urine escapes by fistulous openings, and the canal is collapsed upon itself; in this case, when a probe cannot be introduced into the urethra through one of the fistulæ, the operation may be tedious and difficult.

OPERATIONS FOR URINARY FISTULÆ.

(*Plate 77, fig. 6, 7, and 8.*)

Urinary fistulæ result from wounds, or from urinary infiltrations, abscesses, etc., etc.

They establish a communication, 1st, Between the bladder and the surface of the integuments, as is sometimes observed after the performance of lithotomy above the pubis; 2d, Between the bladder and the rectum, or vagina; we shall recur to this subject when we treat upon vesico-vaginal, or rectal fistulæ; 3d, Between the urethra and some adjacent cavity, the vagina, or rectum; 4th, Between the urethra and the surface of the integuments, which is the most common; 5th, Accidental and permanent fistulous communications may be established between the urinary passages and the adjacent organs, as is seen in uretro-uterines, reno-pulmonary fistulæ, etc. These varieties have but little connection with surgery.

Urethral urinary fistulæ.—The existence of incomplete fistulæ, or

those with an internal orifice only, has been admitted; but complete fistulæ are much more frequent in occurrence, and more accessible to the surgeon. They have been designated according to their locality, by the titles of penal, scrotal, or perineal fistulæ. Another not less useful distinction depends upon their cause; sometimes they are the result of a wound, of gangrene, of rupture of the urethra, the canal itself being healthy, and preserving its normal calibre; but in other cases, they are coincident with one or more strictures which have led to rupture of the urethra and urinary infiltration. Urinary fistulæ are single or multiple, straight or tortuous, simple or complicated with sinuses, with induration of the soft parts, with calculi in their passages, etc., etc., all of them circumstances which exert more or less influence upon the choice of methods to be adopted for their cure.

Regarding their curability, we can say, in a general way, that it is less probable the more nearly the fistulous track approaches a direct course, and also when it is large, and accompanied by loss of substance, and when it opens in the penis rather than the perineum, etc., etc. The surgeon always commences by exploring the urethra; if there be a stricture, it is first treated in an appropriate manner, and it not unfrequently happens that the fistulæ heal spontaneously when the normal passage for the discharge of the urine is established. The numerous means in use for the treatment of urethral urinary fistulæ, may be classed under two heads. In the first, the therapeutical means are indirect, the object being to prevent the flow of the urine into the fistula; in the second, which embraces a great variety of methods, the treatment is directed to the fistulæ themselves, and the soft parts which surround them.

Indirect treatment.—Old method.—A catheter is introduced into the bladder, and fastened permanently, being unstopped whenever the patient experiences a desire to urinate. Even here the urine sometimes passes down between the catheter and urethra, and escapes into the fistula. To prevent this, it has been proposed to allow the catheter to remain unstopped, that the urine may escape as soon as secreted. Boyer advised the substitution, for the catheter, of a very large bougie, which would completely fill up the canal, to be removed by the patient whenever he wished to urinate. The old method is adapted for the treatment of cases when there are strictures, and when the fistulæ are very recent, free from complications, and situated in the perineum, or scrotum.

Ducamp's method.—Repeated catheterism.—The permanently retained catheter is occasionally productive of serious inconveniences; even keeping an unstopped catheter in the bladder is not devoid of danger. Ducamp therefore proposed another method, which consists in preventing the urine from escaping into the fistulæ, by introducing a catheter whenever the patient felt a desire to urinate; this has been found useful when the fistulæ were situated in the penis, producing much less irritation of the urethra than an instrument which is retained for any considerable space of time.

Direct treatment.—This includes compression, injections, cauterisation, incisions for the purpose of uniting adjacent fistulæ, the excision of callous portions of tissue, and finally the suture, or urethroraphy and urethroplasty. These operations are well adapted to the treatment of fistulæ of the perineum and scrotum; they cannot be described as operations, for they differ considerably according to the nature of the case.

The suture, and autoplasty of the urethra, are best adapted to the treatment of fistulæ of the penis.

Urethroraphy.—This operation can be tried when there is only a small loss of substance of the inferior wall of the urethra, but it rarely succeeds; the edges of the fistula are pared off, giving it a more elongated shape, the callous portions are removed as much as possible, points of the ordinary, or the twisted suture, are then introduced, and the lips of the wound brought together over a gum-elastic catheter, previously introduced into the urethra.

Malgaigne attributes the frequent failures of urethroraphy to the presence of this catheter; he therefore advises the surgeon to try repeated catheterism in the place of it.

The lateral incisions of Dieffenbach are useful in securing the success of this operation. In such cases the suture is advantageously combined with autoplasty, by sliding the flap.

Urethroplasty.—Three autoplastic operations have been devised for restoring losses of substance to the urethra. Astley Cooper, Carle, and Delpech, all adopted the Indian method, which is well suited to the disease when situated near the scrotum. The abundance of integument here, allows the surgeon to repeat the operation several times when previous attempts have failed; the skin might also be taken from the thigh, groin, etc. The Italian method rarely succeeds; the French method is preferable,—autoplasty by sliding the flap,—the

operation being favored by the laxity of the integuments of the penis. Two lateral flaps are dissected up, and brought together at the median line; but Alliot says, that it is better to make a small quadrilateral flap on one side of the fistula, and then removing a corresponding piece of skin on the other side, to fit this flap into it, as a tenon is fitted into a mortice. The line of suture is thus placed on one side, and is less liable to contact of the urine. It is our duty to mention, that failures, and even partial successes, are very frequent in this operation, and that a cure in most cases is only obtained after several repetitions.

Imperforate glans.—Enlargement of the meatus (Plate 77, fig. 9, and 9 *bis*).—The glans may be imperforate at birth, in which case it requires the immediate intervention of surgery. In most cases the urethra is distended with urine behind the obstacle; in such cases it is only necessary to make an incision in the usual locality of the meatus, and to introduce a trochar until it enters the dilated urethra; the new passage, thus formed, is kept open by means of large sized catheters, which are permanently retained until cicatrisation is effected.

The discharge of urine and semen is sometimes partially obstructed by a too narrow meatus, or by partial adhesion forming two small orifices, one lying above the other; when the introduction of catheters or instruments for performing the operation of lithotrity become necessary, this slight deformity requires an operation, and is often not complained of before.

Incision is generally adopted; a narrow, straight, or hook-shaped bistoury, is introduced into the canal, about the third of an inch, its point being covered with a small piece of wax; the handle of the instrument is then elevated so as to bring out the point at a proper distance for forming an ordinary sized meatus, when the section is made with a single stroke of the knife; the same operation may be performed for slight hypospadias.

Civiale's method.—A small concealed lithotomy knife is introduced closed into the urethra, then opened as far as necessary, and withdrawn, making the proper section of the tissues at a single cut—without previously informing the patient. The incision is made towards the frœnum. Whatever method may be adopted, the reunion of the lips of the wound must be prevented by the interposition of a foreign body.

Fastening of catheters and bougies to be permanently retained (Plate 77, fig. 10).—The catheter ought not to be passed more than an inch beyond the neck of the bladder; the threads by which it is maintained in position are placed at the same distance from the meatus, this allowance of two inches being made for erections.

First method.—If the patient wears a suspensory bandage, four pieces of tape are fastened to it—two above and two below, which are tied to the bougie, or catheter, care being taken not to draw the knot so tight upon the latter as to close it.

Second method.—A piece of soft cotton cord being attached to the extremity of the catheter, its ends are carried behind the corona of the glans and tied together, they are then separated and brought in different directions around the glans and fastened upon the dorsum of the penis, by means of a bow-knot, which can be tightened, or loosened, at pleasure.

Third method.—A cotton cord is tied to the catheter, and its ends brought down upon each side of the penis, and there fastened by winding a small piece of sticking plaster loosely around the organ; this method is the most simple and solid. A small strip of India rubber cloth may be used instead of the sticking plaster.

Fig. 1

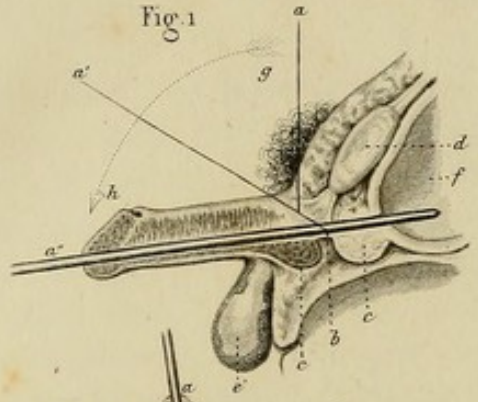


Fig. 3.

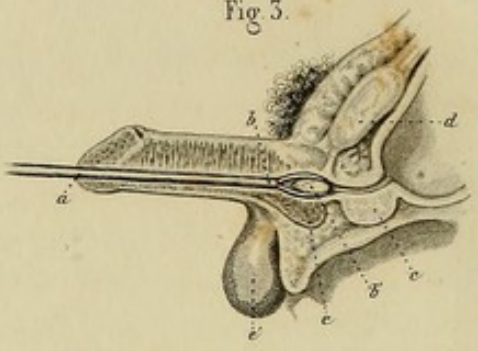


Fig. 2

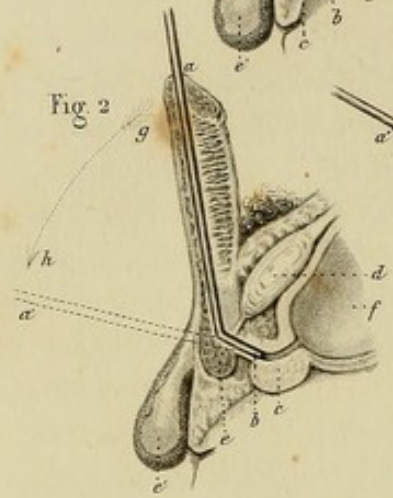


Fig. 2 bis

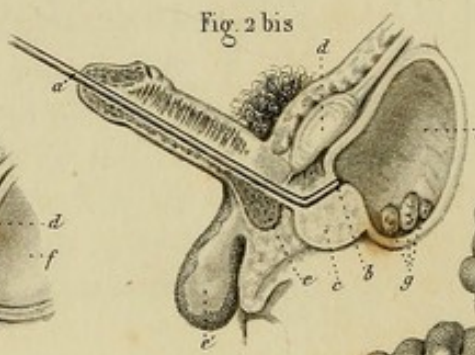


Fig 4 bis

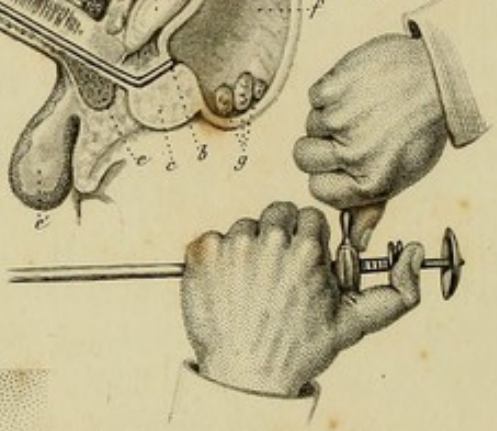
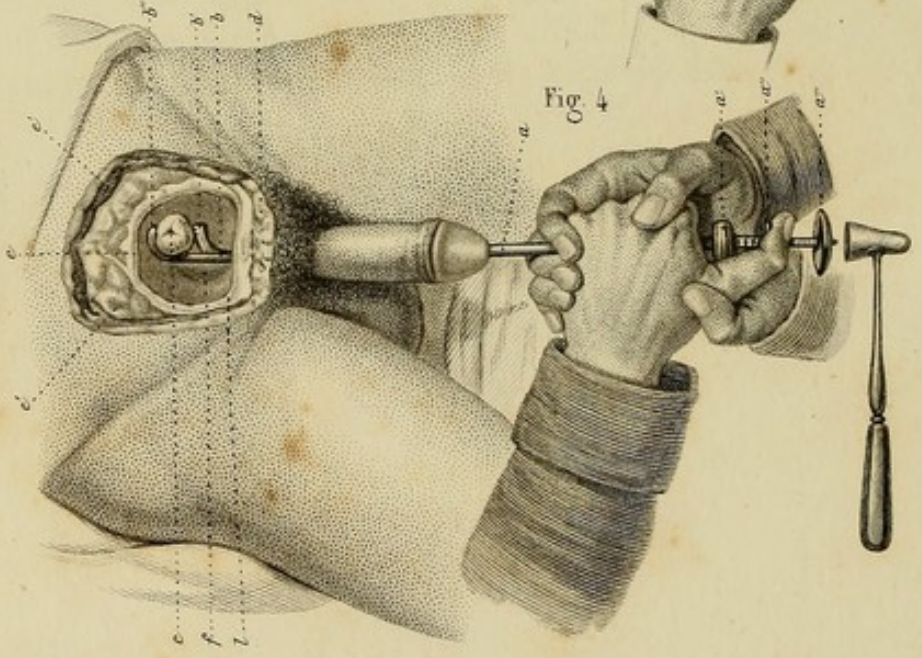


Fig. 4



Lévrillé del.

Daveine sc.

Plate LXXVIII.

CATHETERISM AND LITHOTRITY.

Fig. 1. *Introduction of the straight catheter.*—*a*, position of the catheter in the first step of the operation; *a'*, position of the catheter in the second step, showing the inclination which must be given to the instrument to carry it below the pubes and introduce it into the membranous portion *b*; *a''*, the catheter, carried through the canal into the bladder; *g*, *h*, the quarter of a circle through which the instrument passes in the three steps of the operation; *c*, the prostate gland; *d*, the symphysis pubis; *e*, the bulb; *e'*, the testicle; *f*, the bladder.

Fig. 2. *Introduction of the exploring sound, and of the instruments used for the operation of lithotrity.*—*a*, position of the sound in the first step of the operation; *a'*, position of the instrument when introduced into the bladder; *b*, the point of the sound just entering the prostatic portion; *g*, *h*, the fourth of a circle described by the instrument; *c*, the prostate gland; *d*, the symphysis pubis; *e*, the bulb; *e'*, the testicle; *f*, the bladder.

Fig. 2 *bis. Introduction of the exploring sound.* Position of the calculi.—*a*, the exploring sound, or lithotrite, carried through the urethra, and about to enter the bladder; *b*, its extremity, passing through the neck; *c*, the prostate gland; *d*, the symphysis pubis; *e*, the bulb; *e'*, the testicle; *f*, the bladder; *g*, calculi lodged in the bas-fond of the bladder, below and behind its neck. This situation explains the difficulty sometimes experienced in reaching them with the ordinary curved sound, the difficulty being avoided if a sound with a slight curve is used, and its point turned downwards and backwards.

Fig. 3. *Extraction of a calculus lodged in the urethra.*—*a*, *b*, forceps with straight branches introduced to the membranous portion; *b'*, a calculus caught between the jaws of the forceps, and about to be extracted; *c*, the prostate gland; *d*, the symphysis pubis; *e*, the bulb; *e'*, the testicle.

Fig. 4. *Lithotrity—Method by percussion.*—A calculus caught between the jaws of the lithotrite, in the bladder.—*a*, the lithotrite; *a'*, a hollow cylinder attached to the female branch; the male portion is furnished with cogs which project into the cylinder and fit into a pinion, by means of which the branches are moved backwards and forwards upon each other; *a''*, a circular plate attached to the male branch, and used as a support for the fingers; *a'''*, a disk terminated by a button, also attached to the male branch, which receives the blow of the hammer when the stone is broken by percussion.

The lithotrite is held firmly in place by an assistant, with both hands, the surgeon also using his left hand for the same purpose, holding the hammer in his right hand.—*b*, the vesical extremity of the lithotrite; *b'*, the male branch; *b''*, the female branch; *c*, the calculus; *d*, *e*, *e'*, *e'*, a section of the walls of the abdomen and of the bladder, showing the action of the instrument in the interior of the bladder, *f*.

Fig. 4 *bis*. This figure shows the manner of using the pinion. The lithotrite is firmly grasped with the left hand, the thumb pressing firmly upon the male branch. The pinion being inserted into the cylinder, is grasped with the right hand, and rotated upon its axis The cogs of the pinion and male branch being inserted into each other, the latter is put in motion, and the jaws of the instrument separated, or brought together, as desired.

LITHOTRITY.

Lithotrity, as its name indicates, is an operation performed for breaking up calculi in the bladder, without making an incision.

The idea of the operation is very ancient; allusions are made to it by Azzarhavi, Benedictus Sanctorius, and Fabricius Hildanus. The histories of the monk of Citeaux, and Major Martin, are everywhere cited, each of whom succeeded in breaking calculi in his own bladder by methods which exhibit a certain amount of ingenuity. The most important advances were made by Gruithuisen (1812), a Bavarian physician, who very clearly described perforation of the stone; and Elgerton, who invented a very ingenious rasp (1816). These inventions, however, had not as yet been introduced into common

use, when the labors of Civiale, Amussat, and Leroy d'Etiolles were made public, at very nearly the same time (1818, 1822).

Since that period, so much attention has been paid to lithotrity, and so many modifications and improvements have been appended to it, that it would be both tedious and difficult to trace out even an abridged history of the operation.

1st. The first class of contra-indications to the performance of this operation relates to age and sex. Lithotomy is very successful in children, the calibre of whose urethræ prevents the introduction of instruments of the proper size for crushing the stone. Attempts have been made to set aside this latter objection, but the majority of surgeons consider lithotrity an improper operation before the age of puberty.

In the female, vestibular lithotomy is simple and rarely dangerous; besides, the brevity and dilatability of the urethra allow the extraction of very large calculi. These reasons do not appear to us to militate against the performance of lithotrity, for they are also favorable to the success of the latter operation, which can be performed with very strong, straight instruments, with the production of little or no pain.

2d. The pathological condition of the genito-urinary organs, and of the bladder in particular, constitutes the greatest obstacles, and furnishes the most serious objections to the performance of this operation.

Lithotrity is hardly proper when there is concentric hypertrophy of the bladder, or when its thickened walls are almost moulded over the surface of the calculus. The movement of the instrument, in such cases, is very difficult, and even dangerous.

The same objection is applicable to cases where the bladder is very sensitive, or when the contact of the lithotrite produces spasmodic contractions of the organ. This spasmodic condition may occur when there is no organic disease whatever, as it sometimes depends solely upon the extreme sensibility of the patient; but it is more frequently, owing to a morbid condition, such as acute or chronic cystitis, or catarrh of the bladder.

Acute cystitis, and vesical catarrh, being frequently kept up by the presence of calculus, the first indication is to remove the foreign body; and cases are on record in which lithotrity has proved successful even when performed under such unfavourable circumstances. In all cases, the surgeon should proceed with the greatest prudence, and cease all further attempts if the inflammatory symptoms become more

aggravated. Well marked cancer of the bladder interdicts every species of operation. The calculus may be broken up even when there is a paralysis of the bladder; but this condition is very unfavourable, because the fragments cannot be readily expelled, and are liable to remain, where they may become nuclei for new calculi.

Partial hypertrophy of the prostate gland does not contra-indicate lithotrity, except where it causes so great a deviation of the urethra as to render the introduction of instruments difficult. If the hypertrophy is general, the urethra is rather enlarged, and the afore-mentioned objection no longer exists; but if a vesico-prostatic calculus should happen to be detected, lithotomy would be preferable.

A spasmodic, or organic stricture of the urethra, hypospadias, the presence of a calculus in the canal, etc., etc., are not contra-indications to the performance of lithotomy, they only postpone its application. These affections must be treated, or palliated, so as to allow of its performance. It is very rare that the symptoms produced by the presence of a calculus are so urgent that its removal cannot be deferred.

3d. The nature and position of the calculus itself furnishes certain contra-indications; as, its very large size,—its extreme hardness, for instance, when it consists of the oxalate of lime,—when it is buried in a sacculus of the bladder,—or in the terminations of the ureters; all of these are conditions which render lithotrity, to a greater or less degree, impracticable. The shape and number of the calculi, although not very serious obstacles to the performance of lithotrity, yet, as in the preceding cases, give the preference to the operation of lithotomy.

4th. The concurrent alterations of the superior portions of the urinary apparatus,—the ureters, the pelvis of the kidneys, and the kidneys themselves, are frequent causes of the ill success and unfortunate termination of the various operations in vogue for the treatment of stone in the bladder. Some authors think that the contra-indications which we have enumerated apply with equal force to lithotrity and lithotomy, but they do in reality stand in greater opposition to lithotrity, which ought never to be performed in extreme cases; for it has frequently been necessary afterwards to perform the operation of lithotomy, thus exposing the patient to the hazard of both operations.

The numerous modes of performing the operation of lithotrity may be divided into three classes, according as it is proposed to wear away the calculus by degrees, to crush it, or only to break it into pieces. Three methods are divided from these: *pulverisation*, *crushing*, and *breaking up*. A great variety of instruments appertain to each of these methods; these may be sub-divided into straight and curved instruments. Many of these instruments and modes of operating are now abandoned, and belong only to history. They will not occupy our attention.

Breaking up.—Crushing.—This is the method most in use; it consists in reducing the calculus to fragments small enough to pass readily through the urethra; it amounts to the same thing as pulverisation in its results; the mechanical action by which it is accomplished is very simple, resembling the movements of the thumb and fore finger, which represent the lithotrite in the act of crushing a soft calculus. When the calculi are soft and of moderate size, they are completely broken up, or very nearly so. When they are large and hard, they are first broken into fragments and then crushed. This operation can be effected with the forceps having three or more branches, all the various instruments employed for the purpose taking the general name of *lithotrite*. They present a very abrupt curve at their vesical extremity, and consist essentially of two parallel metallic rods, or branches, which slide lengthwise, one upon the other. The strongest of these rods has a deep groove cut in it, into which the other slides, fitting so accurately that separation of the two is impossible. The first is called the female, and the second the male branch. When closed, these two pieces resemble a catheter composed of three portions: one vesical, terminated by two differently shaped extremities, which are called the jaws, between which, when separated, the stone is caught. The spoon-shaped,—the grooved instrument,—the lithotrites with fenestræ, etc., all take their names from the shape of these extremities, according as the male jaw enters a mortice cut in the female, or only into a groove, or when the jaws, the male convex, and the female concave, close together like a duck's bill. Notches are cut in the faces of the jaws where they come together, the object of which is to enable them to retain a firm hold upon the calculus. (Instruments, plate XXI., fig, 8, 9, 12, 13.)

The external extremity of the lithotrite is much larger; various kinds of mechanical contrivances have been attached to it for the purpose of moving the male upon the female branch, and bringing the jaws forcibly together. The eccentric screw, the central screw, and the pinion, are most in use; by their aid, a very considerable degree of force can be applied, which ought always to be proportioned to the size and strength of the branches and jaws of the instrument. The middle portion of the instrument resembles an ordinary catheter, and ought to be from ten to twelve inches in length, to enable the surgeon to execute the various manipulations with facility.

The preceding general description does not apply to all known varieties of lithotrites, especially to that of Jacobsen, which, in spite of Dupuytren's improvement, is now but little used.

Breaking into fragments.—The object of this method is to break the calculi into pieces, and is usually applied to such as are very large or very hard; it is simply a prelude to crushing and ought not to be adopted alone, as the pieces of stone which result after its performance are too large and angular to pass through the urethra without causing serious consequences. The degree of force which can be produced by ordinary lithotrites usually suffices, in the great majority of cases, to effect this first step of the operation in a satisfactory manner. But, when the calculus resists all prudent attempts, it is then advisable to try percussion. The male branch of the lithotrites is terminated by a broad button which may be struck with a hammer; in such cases the stone usually breaks into two pieces, which can be caught separately and again broken in the same way. If the calculus, although large, is not very firm, it can be broken up by means of the pinion and central screw, not by continuous pressure, but by bringing the jaws suddenly and vigorously together upon it; very strong lithotrites, with fenestræ in the jaws, should be used for this operation, which is a species of preparation for crushing. When a great deal of force is required, the lithotrite can be firmly fixed by means of a vice arranged for the purpose, by which arrangement the instrument only operates upon the calculus, without endangering the posterior aspect of the bladder. Amussat and Heurteloup have both invented apparatus for this purpose. Thus, the methods of breaking up and crushing are so combined that the calculi are broken into pieces, which are successively caught and crushed to the extent desired. (Instruments, plate XX., fig. 27; plate XXI., fig. 8, 9, 12 and 13, and plate XXII., fig. 7.)

Modes of exploring.—1st. *To discover the stone.*—The forceps with three branches is very useful for this purpose; after opening it in the bladder, it is turned upon its axis; in this way each of the branches sweeps over the bas-fond of the bladder, one of which is almost certain to come in contact with the calculus. Mercier's catheter, and the ordinary lithotrites with the short curves, are also very useful, possessing great advantage over the usual curved sound, and still more over the straight instrument.

2d. *The number of the calculi.*—The multiplicity of points of contact, or the existence of hard bodies at several points in the bladder, will furnish reason to suspect the presence of several calculi.

3d. *Dimensions of the stone.*—If the simple sound, or the lithotrite, is used with dexterity, the surgeon can dispense with the use of special instruments for determining the size of the stone. (Instruments, plate X., fig. 7, and plate XX., fig. 27.)

At every operation, the surgeon should ascertain the exact situation of the calculus before opening the instrument in the bladder.

Preliminary operations.—Position of the patient and the surgeon.—The bladder should be distended by fluid; the patient may, therefore, be instructed to retain the urine for a few hours before the operation, or, in case of necessity, tepid water may be injected into the bladder; manipulations with the instrument are thus rendered easier, and much less dangerous. Anæsthesia may be adopted when there is marked sensibility. Ivanschich (of Vienna) has found the latter of great benefit; the general rules and indications being followed, it may also be adopted in cases of spasm of the urethra and bladder. Otherwise, anæsthesia does not seem to be called for. The patient may be placed in the same position as for the operation of lithotomy; the thighs, however, do not require to be abducted, or flexed, to so great an extent. The surgeon, after introducing the instrument as in ordinary catheterism, takes his position, either standing or sitting between the thighs of the patient. If the latter be not tied, a sufficient number of assistants are required to hold him quiet; an assistant should also be ready to aid the surgeon, particularly if percussion is adopted. The use of the lithotrity bed is now abandoned.

1*st step.—Introduction of the instrument.*—Everything being properly arranged, the instrument, according as it is straight, or curved, is introduced in the manner already described (see *Catheterism*). The meatus sometimes requires to be incised, owing to the large size

of the lithotrites. Union of the wound between the operations should be prevented. The curved extremity of the lithotrite should be swept around the bladder, and as soon as the stone is felt, all motion should cease. Then keeping the instrument in contact with the stone, the surgeon should open it very slowly and carefully, so that he can seize the calculus as soon as the branches are separated. Calculi usually lie in the bas-fond of the bladder, either in the median line, or to one or the other side; to seize them, the instrument must be turned so that the opening of its jaws looks downwards and backwards, the other extremity being elevated to suit the depth, or shallowness, of this portion of the bladder. A finger introduced into the rectum or vagina, by raising the postero-inferior wall of the bladder, may aid in seizing the stone.

When the surgeon supposes the stone to be caught between the jaws of the lithotrite, he should slide the male branch gently, so as to get a firm grasp upon the calculus. This can be done with the left hand; if the stone is not fairly seized, it suddenly escapes, and the jaws close; the manœuvre must then be repeated. When the calculus is fairly caught, the instrument should be rotated upon its axis, and carried backwards and forwards, so as to be certain that the mucous membrane of the bladder is not seized as well as the foreign body. Sometimes pain is felt when the mucous membrane of the bladder is pinched, and this accident is also recognised by the very limited extent of motion allowed to the instrument; in such cases, the stone must be dropped and caught anew. All these manœuvres require the exercise of a great deal of tact, attention, and practice. All danger being avoided, the jaws are first brought together by the hands alone, which sometimes suffices to break up the stone when it is soft and small, or rather to crush the fragments which have been already broken into small pieces; if, however, the stone resists these efforts, percussion, as already indicated, may be attempted (plate 78, fig. 4), in the manner already referred to.

In a great proportion of cases, the pinion answers every purpose (plate 78, fig. 4 *bis*). The eccentric and the central screw, although of less power and less convenient, are frequently very useful in breaking the stone.

When soft calculi, or small pieces alone require to be crushed, a sudden impulse to the instrument, as in other cases, is not necessary, but the jaws should be brought slowly together, otherwise the stone

will be simply broken, instead of being thoroughly crushed, which is much more desirable. If the spoon-shaped instrument seems better calculated than that with fenestræ for effecting this purpose, it also offers the following inconvenience; the stone is reduced into a sort of resisting powder, which being strongly compressed between the two spoon-shaped jaws, fills them up and prevents their complete closure, thus increasing the size of the instrument materially when it is withdrawn from the bladder. Various mechanical contrivances, unfortunately very complicated in their details, have been invented for cleaning out the cavity of the spoon-shaped lithotrite. Jaws, terminated by teeth which shut into each other, and having a fenestra in the female branch, seem in a great measure to escape this difficulty. The lithotrite has now very generally taken the place of the three branched forceps, which will excuse us from the necessity of describing the latter, although it may sometimes be found useful, when the calculi are small, soft, and numerous.

When lithotrity was first introduced, the operation lasted about ten minutes, the instrument being re-introduced several times. Civiale, recognising the inconveniences of this practice, recommends that the number of the operations be increased, only one or two minutes being employed on each occasion; the operator must be possessed of very great dexterity to obtain any satisfactory result in so short a time. Forty-eight hours are usually allowed to elapse between each operation, rarely less, frequently more, according to the symptoms and complications of the case. The surgeon ought to familiarise himself thoroughly with the performance of this operation, by placing stones in a pig's bladder half filled with water, and repeating the various manœuvres without using the eyes.

When the operation is concluded, the jaws of the lithotrite must be closed as accurately as possible, and the instrument then withdrawn; if the spoon-shaped lithotrite is used, a certain portion of the pulverised debris, and occasionally one or more small fragments remain in the instrument. These are withdrawn with the instrument, and its withdrawal should be effected with the greatest possible prudence, in order to avoid distending, lacerating, or bruising the walls of the urethra.

Discharge of the calculous débris.—A very important result of the operation of lithotrity—the discharge of the fragments, or pulverized debris, may be either spontaneous or artificial. The patient repeatedly

discharges urine loaded with calculous particles, and even with fragments of some size. When the stone has been thoroughly broken, the passage of this powder is effected without difficulty; but when the stone has only been broken into fragments, some of these may be arrested in the urethra, producing acute pain, retention of urine, wounds of the parietes, hemorrhage, etc.; sometimes their spontaneous discharge is effected, the size of some of the fragments expelled occasioning no small surprise; but if this is not the fortunate result, the surgeon is called upon to act in the manner which we shall describe a little further on. The most common causes of this stoppage of the particles of the stone are: strictures or spasm of the urethra, the enlargement of a portion of the canal situated just behind the stricture, paralysis of the bladder, valves at its neck, and hypertrophy of the prostate gland.

Many surgeons have advised the injection of a current of liquid into the bladder after each performance of lithotrity; a very useful precaution. Double catheters are very suitable for this purpose, and among others we would recommend those of Mercier, and Leroy d'Etiolles (Instruments, plate XXI., fig. 2). A current of warm water may be first injected, to wash away the powder, and afterwards some emollient liquid, which will soothe the irritation of the mucous membrane of the bladder.

The accidents which may result from the performance of lithotrity are numerous; some of them are slight, but others are very serious, fully as much so as those which happen after the operation of lithotomy. They may be either local or general, and attributable either to the surgeon himself, or the susceptibility of the patient.

Breaking of the instruments, particularly of the male branch, is not rare; if the pieces cannot be extracted, the operation of lithotomy will be required. The bladder may be perforated, a portion of the mucous membrane, even some of its muscular fibres may be pinched between the jaws of the instrument and the calculus, and torn away. Hemorrhage has been produced, probably in consequence of some lesions of this nature. Cystitis, nephritis, and peritonitis, have followed the operation, and sometimes with fatal consequences. The same is true of retention of urine, and rupture of the bladder. Infiltration of urine, and phlegmonous inflammation of the perineum, have resulted in consequence of laceration of the urethra, or blad-

der. The urethra itself has been perforated by instruments, and by angular fragments caught in the canal. The latter accident is frequent.

Urethritis, acute or chronic inflammation of the prostate gland, and orchitis, are sometimes produced by the very frequent introduction of instruments.

Severe phlebitis, producing œdema of the extremities, has been noticed in some cases; and, in rare instances, the performance of lithotrity has been accompanied and followed by excessive pain, the cause of which is unknown.

Finally, lithotrity, like all other operations upon the urethra, sometimes produces those singular rigours, or chills, followed by fever, and occasionally serious enough to be dangerous; these may be simultaneously complicated by grave symptoms in the digestive canal, in the lungs, or the brain. Phlebitis of the spongy and erectile tissues of the penis, and of the venous plexus around the neck of the bladder, is probably the cause of some of these symptoms. Death, at all events, is sometimes the result.

Without entering into details of prophylaxis and therapeutics, we offer the following precepts:

Do not undertake the operation of lithotrity except in very simple cases, and when it is formally indicated.

Perform the manipulations required, with the greatest prudence, and only after a thorough practice of them upon the subject, and otherwise.

Let the operations be short, and allow a sufficient time to elapse between them for the entire subsidence of all symptoms which may have arisen from their performance.

Give the greatest attention to the consecutive treatment, between the operations, and also establish fixed rules for regimen, exercise, etc.

Relapse.—This may depend upon the formation of a new calculus, which is not the fault of the surgeon, or some small calculi, or large fragments, may have been left in the bladder which have served as the nuclei for new concretions. Relapse, owing to a lithic diathesis, is as liable to take place after lithotomy as lithotrity; as to the second cause, the advocates of lithotrity say that relapse is not more frequent than after the other operation; this result is drawn from the comparison of a great number of facts.

Plate LXXIX.

SURGICAL ANATOMY OF THE PERINEUM—LITHOTOMY THROUGH THE PERINEUM AND RECTUM.

Fig. 1. *The perineum.*—The left half of the figure represents the superficial layers; the right half the deep layers. The superficial aponeurosis is retained on the left side; *a*, the orifice of the anus and its sphincter, one half of which is uncovered; *b*, the projection of the bulb covered by the accelerator urinæ muscle; *c*, the internal pudic vessels, the artery to the outer side and more superficial, the vein within and deeper; these vessels, after winding around the spine of the ischium, pass between the two sacro-sciatic ligaments, and appear above the large ligament of the same name *d*; they then proceed forwards, side by side, to the internal aspect of the tuberosity, and ascending ramus of the ischium, giving out numerous branches in their course, the most important of which pass towards the median line; these are: *f*, the superficial artery of the perineum, which is distributed to the integuments, and is ultimately lost in the scrotum; *f'*, the inferior hemorrhoidal, which anastomoses with the preceding, and winds around the anus. The most important branch is the artery of the bulb, which arises in front of the tuberosity of the ischium, and runs along obliquely, forward and inward, through the posterior border of the transversus perinei muscle, and the middle aponeurosis, to reach the bulb. These arteries have their accompanying veins. The pudic vessels, after furnishing these branches, terminate in the penis; *e*, a section of the gluteus maximus, exposing the earlier course of these vessels; *g g*, sections of the skin, exposing the gluteus maximus and its aponeurosis, the origin of the abductors, and the fascia lata, the levator ani, the coccyx, etc.; *h h*, the testicles; *i*, the penis.

Fig. 2. *Bilateral lithotomy.—Introduction of the staff.—Incision of the skin.*—*a*, the anus; *b*, a transverse wound at an equal distance from the anterior portion of the anus, and the projection of the bulb;

Pl. 79

Fig 1.

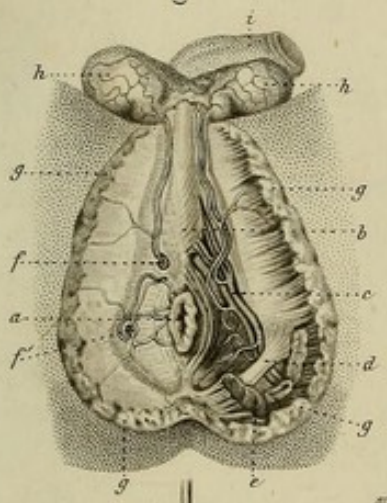


Fig 2

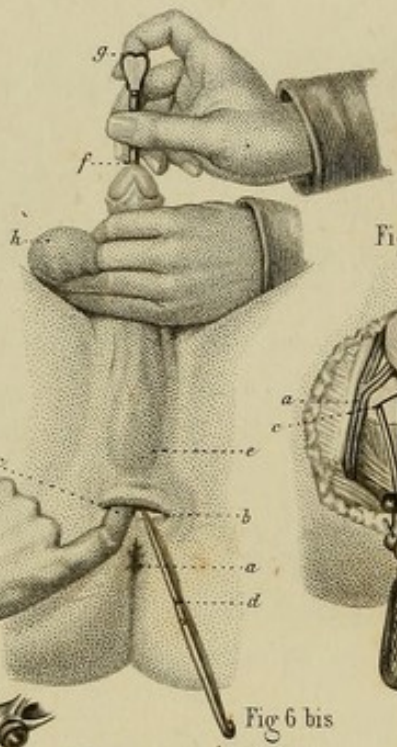


Fig. 3



Fig 3 bis

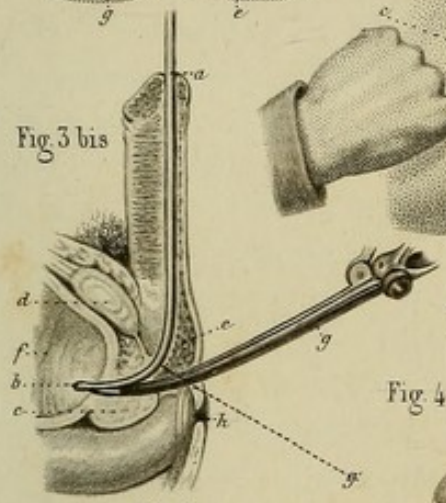


Fig 6 bis



Fig. 4

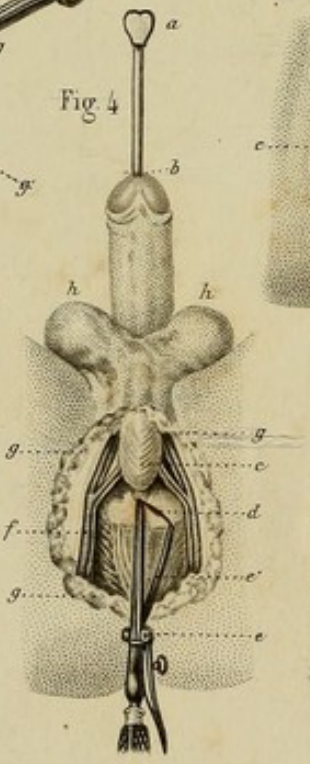


Fig. 6

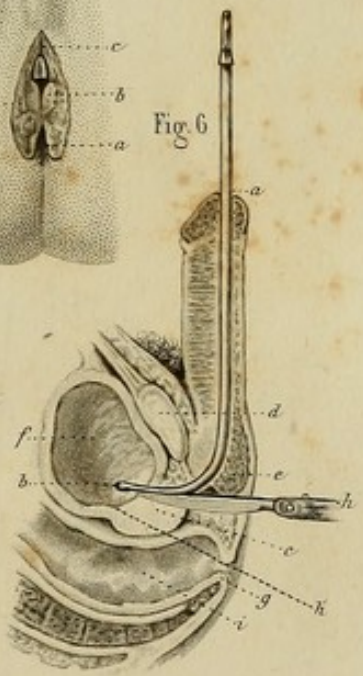
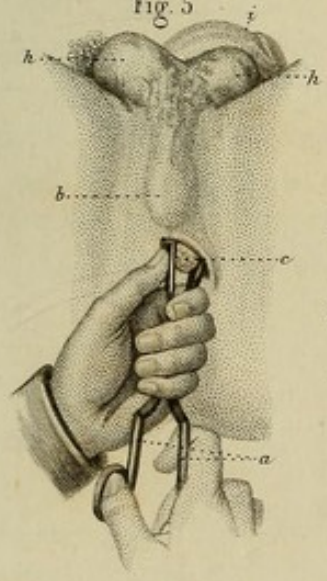


Fig. 5



Léveillé del.

Daveine sc.

c, the left index finger inserted into the wound and feeling for the groove in the staff; *d*, the bistoury; *e*, the bulb of the urethra; *f*, the meatus urinarius; *g*, the staff introduced into the canal, and held vertically in the median line; *h*, the testicles held up towards the abdomen by an assistant, who, at the same time, maintains the staff firmly in its proper position.

Fig. 3. *Incision of the prostate gland in bi-lateral lithotomy.*—The superficial layers have been removed, and the deep parts of the region are shown; *a*, the internal pudic vessels; *b*, the bulb of the urethra, covered by its muscle; *c c*, limits of the curved incision, with its concavity looking backwards, which has been made in the inferior aspect of the prostate gland by the open blades of the double lithotome; in the middle of this incision, a small antero-posterior incision has been made in the membranous portion of the urethra; behind all, the levator ani muscle is shown.

Fig. 3 *bis. Introduction of the lithotome along the groove in the staff.*—*a*, the grooved staff introduced into the urethra; *b*, probe-pointed extremity of the staff in which the groove terminates; *c*, the prostate gland; *d*, the symphysis pubis; *e*, the bulb; *f*, the bladder; *g*, the lithotome, which has reached the neck of the bladder, having been slid along the groove in the staff; *g'*, point where the lithotome is inserted into the groove in the staff, corresponding to the incision in the membranous portion; *h*, the anus.

Fig. 4. *Incision of the prostate gland by the lateral method.*—*a*, the staff introduced into the bladder and held vertically in the median line; *b*, the meatus urinarius; *c*, the bulb of the urethra; *d*, oblique incision made with the open lithotome in the largest diameter of the prostate gland; *e*, the articulation of the blade of the instrument with its sheath; *e'*, the blade, with its cutting edge looking outwards; *f*, the internal pudic vessels; the incision, *d*, which commences at the membranous portion of the urethra, is carried in a direction parallel to the artery of the bulb, and lies at a considerable distance from the main trunk of the internal pudic artery; *gg*, the incision of the integuments and the superficial soft parts which have been removed to expose the deep layers.

Fig. 5. *Extraction of the calculus with the lithotomy forceps.*—*a a*, the branches of the lithotomy forceps held by the rings with the right hand, the left hand grasping the jaws, and pressing upon the calculus, which is being extracted by drawing it downwards and outwards;

b, the projection of the bulb; *c*, the calculus held between the jaws of the forceps; *h h*, the testicles; *i*, the penis.

Fig. 6. *Recto-prostatic median lithotomy.*—*a*, the staff introduced into the urethra and bladder, and held vertically in the median line; *b*, its probe-pointed extremity; *c*, a section of the prostate gland in the median line; *d*, the symphysis pubis; *e*, the bulb; *f*, the bladder; *g*, the posterior commissure of the anus; *i*, the rectum; *h*, the bistoury held horizontally, with its back lodged in the groove in the staff, the edge looking downwards in the median line, the point having been carried to the termination of the groove in the staff; *h'*, a line which represents the limits to which the incision made with the bistoury is carried below, behind, and in the median line. This incision comprises the membranous and prostatic portions of the urethra, the neck of the bladder, three-fourths of the thickness of the prostate gland and its point, its posterior and superior border not being divided. The bistoury is, therefore, carried through all the superficial soft parts of the perineum lying between the bulb of the urethra and the rectum, as well as the anterior portion of the rectum itself, and the anterior commissure of the anus.

Fig. 6 *bis*. This figure shows the aspect of the wound made by the preceding incision. *a*, the section of the anterior portion of the rectum and anus; *b*, the section of the prostate gland; *c c*, the section of the soft parts of the perineum in the space lying between the bulb of the urethra and the anus.

LITHOTOMY.

Lithotomy is an operation in which a passage is opened into the bladder, with cutting instruments, for the purpose of extracting foreign bodies which have been introduced from without, or calculi which have been developed in the urinary passages.

Every possible way of entering the bladder has been tried, and each method has been subjected to numerous modifications; from this circumstance arises the necessity of making a classification of the operations for lithotomy. This has been frequently attempted, especially by Vidal; we shall content ourselves with arranging the operations for lithotomy under three great classes or methods, according to the region interested in the first steps of the operation; we shall divide them into perineal, rectal or vaginal, and hypogastric litho-

tomy. Lithotomy in the female will be described in a separate article.

PERINEAL LITHOTOMY—SURGICAL ANATOMY OF THE PERINEUM.

The name of perineum is given to the inferior boundary of the pelvic cavity; it is a species of diaphragm whose circumference firmly adheres to the bones forming the inferior strait of the pelvis, and consists of numerous muscular and fibrous layers lying between the skin externally and the peritoneum internally.

The muscular and aponeurotic planes which enter into its constitution are variously stratified and crossed one with another, which increases their power of resistance; their fibres are separated from each other along the median line, to give place to natural orifices whose mucous lining becomes continuous with the integument.

In the substance of the perineum, we find hollow organs having a direction nearly vertical; these are, behind, the rectum, which is the termination of the alimentary canal; in front, the neck of the bladder surrounded by the prostate gland, or, in the female, the vagina and the urethra; that is to say, the extremity of the genito-urinary organs.

The blood-vessels and nerves which wind along between the various layers, or are distributed to the hollow organs, make up the general anatomical composition of the perineum; but the differences which the genital organs of the two sexes present in the anterior portion of the perineum of the male and female, renders a special description necessary for each. The posterior portion, which belongs to the apparatus of defecation, is common to both, and with the exception of some peculiarities of the parts lying between the rectum and the bladder, of the vaginal canal and its orifice, the anal region is very nearly the same in the woman as in the man.

The region in which the surgeon performs his operations is comprised, externally, between the root of the scrotum and the anus, and, transversely, between the angles formed, on either side, by the thighs with the trunk.

The layers which are met with before reaching the neck of the bladder are numerous, and have been unnecessarily multiplied by authors; the tenuity of some of them, and the fact that able surgeons divide them without trying to make each of them out distinctly, go

to show that a special description of all of them is of no importance in a surgical point of view. It is much more useful to arrange them in groups, indicating especially the parts of importance, the land-marks, through which the instrument passes to reach the neck of the bladder, and to keep in view the three great precepts of perineal lithotomy, which are: to avoid wounding the arteries, to avoid wounding the rectum, and to make a passage large enough for the extraction of the stone. We shall, therefore, recognise but three layers, and those complex in character.

First layer.—A fine, brown, elastic skin, furnished with hair and sebaceous follicles, continuous with those of the scrotum, surrounds the margin of the anus, and extends upon the internal aspect of the thighs. Two moderately thick and resisting laminæ of cellular tissue represent the two laminæ of the fascia superficialis; between the skin and superficial fascia we find more or less abundant deposit of adipose tissue, increasing in quantity from the scrotum towards the anus; the thickness of this layer varying materially in different individuals; towards its posterior part, immediately in contact with the internal aspect of the integument at the verge of the anus, are some scattered fibres of the superficial sphincter of the anus, which by some writers have been called a subcutaneous muscle.

Second layer.—Above the layer first described, in the median line, and in front, we find the accelerator urinæ muscle, which is thin, and convex on its presenting surface, being moulded upon the sub-pubic portion of the urethra and the bulb which terminates it posteriorly. The pointed extremity of this muscle is continuous posteriorly, by a species of interlacing, with the anterior portion of the sphincter ani. Between these two muscles, and converging towards their point of interlacement, we see the posterior border and inferior aspect of the transversus perinei muscle. External to the accelerator urinæ, we find the erector penis muscle; the first cover the bulb, and are moulded over its convex surface, and the second lie upon and envelop the roots of the corpora cavernosa.

Third layer.—This commences at the middle aponeurosis, or *triangular ligament*, and terminates at the peritoneum, but its inferior portion only is divided in the operation for perineal lithotomy; its upper portion is divided in performing the hypogastric and superior rectal operations. The middle aponeurosis, or triangular ligament of the urethra, is traversed by its membranous portion, and is usually

divided when the latter is opened upon the groove in the staff. This aponeurosis is inserted into the ascending branches of the ischium and the descending branches of the pubes; it extends backwards, towards the coccyx, and has attachments to the aponeurosis of the internal obturator muscle, and is most resisting in front, where it sometimes presents an obstacle to the extraction of the calculus; it is extensively divided by the lithotome.

Above it, and reckoning from before backwards, we find:—

1stly. A loose cellular tissue situated behind the symphysis, and containing numerous veins (the sinus of Santorini), which empty into the dorsal veins; above these vessels are seen the anterior fibres of the levator ani muscle, the vesico-pubic, or prostatic ligaments, and then a second layer of lamellar cellular tissue, which separates the symphysis pubis from a portion of the anterior aspect of the bladder; and, lastly, the peritoneum, passing from the walls of the pelvis to the sides of the bladder.

2dly. We find the neck of the bladder, surrounded, of course in the male, by the prostate, projecting above the superior aponeurosis, or *pelvic fascia*, because the levator ani muscle, the superior surface of which is covered by the *pelvis fascia*, is inserted into the prostate gland, about its middle. The neck of the bladder is situated on a level with the middle of the symphysis pubis, at the distance of nearly an inch from its posterior surface. The tissues intervening between the symphysis and the neck of the bladder are rarely divided by the knife, although this was done by Dupuytren, in his median lithotomy, an operation in which he has had but few imitators. It follows from this position of the neck and orifice of the bladder, that, in making the earlier incisions in perineal lithotomy, the axis of the wound should always be directed forwards and upwards, in a line which will terminate about an inch behind the symphysis. If this precept be neglected, it will frequently happen that the incision will be carried behind the prostate gland into the cellular tissue which separates this gland from the rectum.

3d. The prostate gland usually forms a complete circle, a ring around the urethra and neck of the bladder, yet it is sometimes incomplete in front, but more rarely behind. The greatest thickness of the gland, is behind and along the sides of the urethra and neck of the bladder; therefore, incisions for lithotomy, which necessarily pass

through the gland, are always made either in its transverse, or posterior oblique diameters.

The diameters of the prostate gland have been frequently measured at all ages, particularly by Deschamps, Senn, and Bell. The following table by Senn, shows very accurately the medium of these admeasurements in the adult:

Height of the prostate gland at the median line.	15 lines.
Breadth at the middle part.	22 lines.
From the urethra directly outwards. Transverse diameter.	10 lines.
From the urethra to the middle and inferior portion.	$7\frac{1}{2}$ to 9 lines.
From the urethra to the lateral and posterior angles. Posterior oblique diameter. .	11 lines to an inch.

The incision in lateral lithotomy is made in the last, which is the longest diameter. An opening almost double the size can be obtained by dividing both sides of the prostate in a similar direction. It has been proposed to combine an incision in the posterior oblique diameter of one side, with another in the transverse diameter of the opposite side. As many as four sections of the prostate gland at different points have been made to obtain a satisfactory passage. These various measures have been taken to enable us to calculate, in advance, to what extent we may divide the neck of the bladder and the prostate gland, without carrying the incision beyond the limits of the latter. The older surgeons believed if the incision was extended beyond these limits, and the bistoury penetrated the cellular tissue which surrounds the prostate gland, that there was great danger of the infiltration of urine, and of an unfortunate result; hence was derived the argument in favor of small incisions. Other authors, Malgaigne in particular, believe, on the contrary, that carrying the incision to a certain extent beyond the limits of the prostate gland, is of no such serious importance as it has been supposed to be, and that it is better, in this way, to make a large opening through which the calculus can be easily extracted, than to dilate extensively the prostatic and perineal wound, which cannot be

effected without laceration and bruising of the lips of the wound, which play no small part in the list of accidents appertaining to lithotomy.

From these arguments is derived the practice of large incisions; we cannot enter into a discussion of the relative merits of these two methods of practice, but we believe that the second doctrine has a better basis, and that it agrees more thoroughly with the general principles of surgery. It is well understood, when the large incisions are made, that they shall not be so extensive as to injure the adjacent organs, or important vessels. The prostate gland is thickest above and behind, at its base, than below and in front, where its apex is located. The latter is divided, to a certain extent, in median lithotomy, and sometimes in the operation called "*boutonnière.*" The posterior aspect is divided in rectal lithotomy.

The ejaculatory ducts pass through the prostate gland from above downwards, and from behind forwards, along the median line, and towards its superior and posterior portion, to open into the urethra; median lithotomy, which is performed too high up, almost necessarily divides these ducts; this is one of the principal reasons for abandoning this operation. The insertion of the anterior fibres of the levator ani upon the external surface of the prostate gland causes a part of it, with the membranous portion of the urethra, to be comprised in the interval which separates the middle aponeurosis from the superior or *pelvic fascia*, while, together with a part of the bladder, it is raised considerably above this latter aponeurosis. By considering the peritoneum as the superior limit of the perineum, we give no room for discussing whether the prostate is situated in the substance of the perineum; the gland is surrounded on every side by a very resistant fibrous sheath, which is formed from the condensation of the adjacent cellular tissue. In front, behind, and on the sides, the prostate gland is surrounded by the levator ani, which holds it suspended, as it were, in the centre of the region, while its superior circumference is bounded on every side by the inferior aspect of the bladder; above and behind is situated the bas-fond, to which we shall recur when treating of rectal lithotomy, and with which the vasa deferentia and vesiculæ seminales are closely connected; on the sides, the bladder extending beyond the prostate is found directly in relation with the fibres of the levator ani; at this point it would, therefore, be accessible to instruments, without the necessity of dividing the prostate, by means of a

perineal incision parallel to the internal aspect of the ischium. This part of the bladder was opened in performing the lateral operations of Thomas and Foubert, which are now abandoned.

The rectum is situated behind the prostate gland, and projects into the perineal region, particularly when it is dilated or filled with fecal matter, hence the possibility of wounding it, when the open lithotome is carried too much in an antero-posterior direction. The relations of the rectum with the bladder show how the finger, when introduced into the intestine, can detect the presence of a calculus, and cause it to project into the hypogastric or perineal region. In the same way the rectum can also be depressed, and all injury to it be avoided. In lateral lithotomy only is there danger of this accident; in the bi-lateral operation the incision is made along the anterior aspect of this organ.

Further on we shall give a more thorough description of the relations of the rectum with the bas-fond of the bladder, the prostate gland, and the vesiculæ seminales, when we describe the operations for lithotomy through the rectum, in which this organ and the neck of the bladder are both interested.

PERINEAL LITHOTOMY—MODES OF OPERATING.

Perineal lithotomy includes a great number of methods, which may be divided into prostatic and non-prostatic, according as the prostate gland is interested or not in the incisions. We will only describe the first, the latter being abandoned. We shall, however, enumerate the others, although not advising their employment.

1st. The *apparatus minor* does not really belong to vesical lithotomy, properly so called; it consisted in dividing the membranous portion, and also a part of the prostate, to enable the surgeon to reach a calculus caught in the neck of the bladder and superior portion of the urethra; it was an ill-defined operation, performed without a conductor, and was in some respects analogous to the operation now known by the name of urethral lithotomy, or the "*boutonnière.*" We shall consider it under this head.

2d. The *apparatus major* is allied to the preceding operation, so far as the incision was made in the median line, and carried down to the neck of the bladder, and perhaps also to the point of the prostate. In all cases, efforts were made to dilate, to increase the size of the incision in the gland by laceration, rather than to make an incision

in the first place which was large enough to extract the calculus. It differs from the apparatus minor only in the extent of the incision, which was always carried through the neck of the bladder, and in the great number of instruments which were employed. The most important of these instruments, without contradiction, is the conducting staff, which is now indispensable in the performance of all operations of lithotomy.

3d. Yet median lithotomy has not been completely abandoned, even in modern times. Dupuytren and Thomson divided the anterior portion of the neck of the bladder, and the prostate in the vicinity of the pubes; this method, which should be named *anterior median lithotomy*, has now fallen into disuse.

4th. In a variety of *lateral lithotomy*, Thomas and Foubert endeavoured to penetrate the bladder without touching the prostate, by following a line drawn from the middle of the latter, which separates the tuberosity of the ischium from the anus, and takes a direction parallel to the ascending ramus of the ischium; the bladder is thus reached to the outer side of the prostate, towards the anterior portion of the bas-fond. This method is dangerous, and was rejected from the first.

4th. *Lateral lithotomy.*—This, which might be called the ordinary method, we shall describe more particularly.

Instrumental apparatus.—This has been very much simplified at the present time; it consists of straight or convex bistouries, either single or double-edged, firmly fastened in a handle; long probe-pointed bistouries, either with an edge carried along their entire length, or only to a moderate distance from the point; curved staffs, with a groove in their convex portion, having an olive-shaped enlargement at their vesical extremity in which the groove terminates, and which serves as a support for the lithotome caché of frere Come, whose simple mechanism is well understood; Hawkin's cutting gorget is but little used at the present day; in all cases, the bistoury may be used to divide the prostate gland in the place of any of the instruments specially constructed for that purpose. (Instruments, plates XXI. and XXII.)

Other instruments, for the purpose of extracting the calculus, are used; these are: the blunt gorget, which serves as a conductor for the forceps; the blunt stylet, which is also used for the same purpose, and which is furnished with a spoon-shaped extremity sometimes use-

ful for removing small calculi; straight or curved forceps, the branches either straight or crossing each other, fixed, or moveable, like the obstetric forceps, a syringe and catheter with which the bladder can be distended and cleansing injections thrown into it.

Position of the patient.—Formerly the operation of lithotomy was performed upon a bed made expressly for the purpose, upon which the patient was laid and firmly fastened by cords and straps. This is no longer employed; but the patient takes his position upon an ordinary table, where he is properly held by assistants; if, however, there is a lack of the proper number of the latter, the limbs may be fastened in the following manner:—The thighs are strongly flexed on the pelvis, and the legs on the thighs, so that the heels touch the buttocks, the limbs being forcibly abducted. The patient being in a horizontal position, the pelvis is made to project slightly beyond the edge of the table, so as to make the perineum as prominent as possible. The arms are carried down parallel to the trunk and over the external aspect of the thighs, and the wrists then fastened to the ankles with a bandage or strap. Five assistants, at least, are necessary; two holding the thighs apart and the pelvis firm, another steadying the trunk, a fourth takes charge of the instruments, while the last, who should be the most efficient, holds the staff and draws up the scrotum, his position being usually on the right side of the patient's chest.

Position of the surgeon.—As soon as the staff is introduced, the surgeon takes his position between the thighs of the patient, opposite the perineum; he either stands, sits, or places one knee upon the floor, according to the height of the table. The perineum should have been previously well shaved, and the rectum emptied, the patient having also been instructed to retain his urine for a few hours before the performance of the operation. The stone should be felt for the last time with the staff, after which the latter should be slightly inclined towards the right groin. Surgeons differ as to the proper time for introducing the staff; some recommend that it be introduced before the patient is placed in position, and others after everything is ready for commencing the operation. The assistant should press strongly upon the staff, so as to make the membranous portion project downwards and to the left side, that is to say, towards the side in which the incision in the soft parts is made. The operation is performed in three stages.

1st *Stage.*—The surgeon, holding the bistoury in the first position, makes an incision in the skin in the course of a line, commencing at the *raphé* one inch in front of the anus, and terminating in the middle of the space lying between the tuberosity of the ischium and the anterior part of the anus; the integuments, the sub-cutaneous layers, the superficial aponeurosis of the perineum, are successively divided, and the accelerator urinæ muscle is reached. The general axis of the wound should be directed forwards and upwards, so as to avoid wounding the rectum, and to come down upon the membranous portion; the left index finger should be frequently inserted into the wound, to feel the condition of the parts and serve as a guide for the knife. The operation having been carried to this point, the surgeon attempts to feel the staff through the membranous portion; but the bulb sometimes projects too much to allow the finger to pass beyond it, or to press it towards the spongy portion; it therefore becomes necessary, after dividing the accelerator urinæ, to incise the bulb itself, which should be done on the side in the same direction as the remainder of the wound. By giving a little motion to the staff no difficulty will be experienced in feeling its groove.

2d *Stage.*—As soon as the staff is well made out, it is held firmly in the vertical direction; the left index finger with its radical border looking downwards, is now thrust into the wound, and the point of the nail inserted into the groove in the staff, the membranous portion only, which is usually thin, intervening between them. The bistoury, held like a pen, with its edge looking down, is then slid along the nail in a direction at right angles with the staff; its point is thrust through the urethra and enters the groove; as soon as the surgeon feels the knife in contact with the groove, he raises the handle so that the point will slide freely along from before backwards, and divide the inferior wall of the urethra; the point of the left index finger is now applied to the back of the knife, and the membranous portion is slit up along the median line for about half an inch, when the nail of the finger is again inserted into the groove; the surgeon now lays aside the straight knife and takes the probe-pointed bistoury, or better still, the lithotome caché; this instrument, with its convexity looking downwards, is held in the right hand, the thumb is placed upon the point of articulation of the blade with the handle, the index and medius fingers being kept in contact with the sheath. The blunt point is carried into the wound along the dorsal aspect and nail of

the left index finger, and inserted into the groove in the staff; it is then slid slightly backwards and forwards, to be certain that the two instruments are in contact; the surgeon now takes the staff in his left hand, and still keeping the two instruments in contact, pushes the lithotome forwards until it is stopped by the extremity of the groove of the staff of the bladder, which being effected, the point of the lithotome is disengaged from the staff, and the latter is withdrawn from the bladder.

3d. *Stage.*—The calculus being again felt with the point of the lithotome, the latter is rotated so that its back corresponds with the right side of the pubes, and its edge with the external commissure of the wound in the skin, which position it now retains. The surgeon now grasps the instrument in a manner convenient to himself, and opening the blade as far as he deems advisable, slowly withdraws it in a horizontal direction, and divides the posterior oblique lobe of the prostate gland from within outwards. The incision of the prostate, and that of the soft parts, should be exactly in a line, which is assured by holding the lithotome in such a way that the line of its blade will exactly correspond with the line of the external wound. This is the most important precaution to observe in the whole of the operation. If it be neglected, accidents of various kinds may be the result. If the handle of the instrument be too much depressed, the incision in the prostate gland is insufficient; elevate it too much, and the bas-fond of the bladder is wounded; incline the blade too far outwards, and there is danger of wounding the internal pudic artery, and if the blade be turned backwards, the rectum may be wounded. In all cases, and after due attention to the precepts already announced, the surgeon must not be timid in his incision of the prostate, if he wishes the extraction of the calculus to be easy, and unattended with much laceration; if it be feared that the lithotome, when well-opened, will injure some of the adjacent organs. Boyer's example may be followed, and the instrument closed as soon as the gland is divided, the remainder of the section being performed with the probe-pointed bistoury, in the same direction; or, the soft parts may be slit up in some other direction, as in the bilateral and quadrilateral operations, which we have yet to describe.

Extraction of calculi.—The extraction of calculi consists of three steps; to introduce the forceps, to grasp the calculus, and to withdraw it from the bladder.

1st. *Introduction of the lithotomy forceps.*—The index finger is introduced through the wound into the bladder, and the forceps, closed, is slid along its radial border; but if the finger be too short, the surgeon uses the conducting gorget, or the spoon-shaped stylet, along which the forceps is safely introduced. The conducting gorget is used in the following manner: its concave portion is placed upon the radial border of the index finger, and in this way it is carried into the bladder; the finger being then withdrawn, the groove of the gorget is turned towards the median line, so that it corresponds with one of the borders of the forceps, which is slid along this groove into the bladder, when the gorget, being no longer of use, is withdrawn.

2d. *Seizure of the calculus.*—The stone is sought for and grasped with the forceps in the same way as with the sound. It usually lies in the bas-fond of the bladder. When the bladder is strongly contracted, and embraces the calculus, the proceeding must be conducted slowly and with caution, the forceps being frequently opened and closed, so as to dilate the walls of the cavity. When the position of the calculus is discovered, the instrument is slowly opened, so that the stone will be easily caught between the jaws; the surgeon should try to seize it so that its longest diameter will be parallel to the axis of the jaws, instead of catching it transversely; sometimes it is advantageous to open the branches of the instrument, and use one of them as a scoop, carrying it beneath the calculus; the finger may be introduced into the rectum or bladder, or the curette may be used to assist in seizing the stone. This step of the operation is frequently difficult of execution, and requires the exercise of a good deal of tact.

3d. *Extraction of the calculus* (Plate 79, fig. 5, and plate 80, fig. 5).—The surgeon commences by rotating the forceps, so as to ascertain that no portion of the bladder is caught with the stone, and then closes the handles of the instrument firmly together, so that the calculus will not escape, not using force sufficient to crush it. The force is usually proportioned to the size of the stone. The forceps should be directed downwards, backwards, and to the left side, taking care, however, that it does not come in contact with the symphysis pubis; traction should be cautiously made, lateral and rotatory movements being given to the instrument as it passes through the wound. The mass of the calculus necessarily increases the thickness of the

forceps. If the incision in the prostate be too small, it is better to increase it after the manner recommended by Senn, Vidal, and others, instead of dilating it excessively, or bruising its lips; the description of the succeeding operations will give an idea of the manner in which the surgeon ought to proceed under such circumstances.

Bilateral lithotomy.—Fear of wounding the bladder, or of carrying the incision beyond the limits of the prostate gland, in lateral lithotomy, added to the difficulty of extracting large calculi through an incision of one of the lobes of the prostate only, may be considered as the origin of the bilateral operation, to which a reference was made by Franco. Ledran recommended several incisions; but to Dupuytren the merit is really due of pointing out an operation which is now very justly considered as one of the best methods of performing lithotomy.

The position of the patient, the preliminary precautions, and the extraction of the stone, are the same as in the lateral operation; we shall, therefore, only describe the manner of making the incisions in the perineum and bladder, referring to the preceding operation for the remaining particulars. There is but little difference in the instruments employed. Dupuytren used a peculiar staff, which was lighter than that in general use, except at its middle part, at its greatest curve, where it was enlarged for about two inches, the groove being deeper and larger than usual, and the edges carefully rounded. The groove is carried to the extreme end of the staff. The second instrument for bilateral lithotomy is the double lithotome, which divides the two posterior oblique diameters of the prostate at the same time.

The patient being placed in the proper position, the staff is held perpendicularly in the urethra, in the median line, by an assistant, who also holds up the scrotum; the surgeon makes a semi-lunar transverse incision about half an inch in front of the anus, its convexity looking forwards, and being parallel to the anterior semi-circumference of the anus. The two extremities of this incision correspond exactly to the termination of the incision in the lateral operation; that is to say, about mid-way between the anus and the tuberosity of the ischium on either side.

The skin and the sub-cutaneous layers are successively divided, the incision being always directed towards the neck of the bladder, and care being taken not to wound the rectum, whose anterior portion

lies very near the knife. Having reached the superficial aponeurosis, and recognised the point where the acceleratores urinæ and sphincter muscles unite, this point of union is divided, and the membranous portion arrived at, without the necessity of opening the bulb, which lies in front, and which can be more easily thrust aside, even when enlarged so as to mask the membranous portion; the staff is now felt very distinctly through the urethral walls, which are divided in the same manner as in the lateral operation, and the double lithotome is introduced exactly in the median line, its concavity looking downwards, and its convexity upwards, so that its two blades, when open, will correspond very exactly to the posterior lobes of the prostate.

The lithotome is cautiously withdrawn, so as to make the sections of the prostate correspond as exactly as possible with those of the external wound; but this step of the operation is much less dangerous with the double lithotome than with that of frère Come, which constitutes one of the great advantages of this method proposed by Dupuytren. The lithotome being withdrawn, the calculi are extracted in the usual way.

Senn has modified the incisions of the prostate as performed in this operation; instead of dividing the lobes obliquely, he makes one incision oblique and the other transverse, as by doing thus he considers that a larger passage for the extraction of the calculus is secured.

Chaussier and Beclard invented instruments expressly designed for making the incision of the prostate. The double lithotome is very convenient for making a double section of the prostate, but the simple lithotome, or even the probe-pointed bistoury, will answer every purpose in dexterous hands.

Quadrilateral lithotomy.—The principle of several incisions, and the advantages to be derived from them, have been carried to their utmost limits in the method proposed by Vidal.

The author expresses himself in this way: "*a large external incision, small internal incisions;*" he, however, adopts in the main the cruciform incision, as employed by Dupuytren. The urethra being opened in the usual manner, the surgeon commences by incising the two posterior oblique lobes of the prostate, he then introduces the left index finger to the bottom of the wound, on which a long probe-pointed bistoury is placed flatwise, with its edge directed upwards, outwards, and to the left side (left superior oblique lobe), and then outwards, upwards, and to the right side (right superior oblique lobe);

the gland being divided with the knife in these two directions, the extraction of the stone is very much facilitated, without carrying the incisions beyond the limits of the prostate.

The double superior incision is not indispensable; one, frequently, being all that is required, according to Vidal, who makes one, two, or even three incisions, according to the nature of the case. The calculus is extracted in the manner already described above.

RECTAL LITHOTOMY—SURGICAL ANATOMY OF THE RECTO-VESICAL REGION.

The rectum appertains to the perineum for about half its length, its anterior aspect corresponding more or less directly with the infero-posterior aspect of the bladder, the prostate gland, and the urethra; these relations have suggested the idea of extracting vesical calculi through an incision which involves the rectum to a certain extent.

The distance which separates the vesico-peritoneal cul-de-sac from the surface of the perineum, is about two and a half inches, and in this space, from above downwards, the rectum has the following connections:

1st. With the posterior aspect and bas-fond of the bladder, from which it is separated by loose cellular tissue, and also by the vesiculæ seminales, and the vasa deferentia; these last leave between them a triangular space with its apex below, with which the rectum and the bladder are in immediate relation; it was at this point that Sanson, in his first method, divided the recto-vesical septum.

2d. With the posterior aspect of the prostate gland, a rather dense cellular tissue lying between the two organs. The bladder can, therefore, be reached through the prostate, by dividing the walls of the rectum; but the section of the gland in the median line, as it is made in the operations which we are about to describe, is not sufficiently extensive, and also exposes the ejaculatory ducts to injury.

3d. With the membranous portion of the urethra. We have already shown that the obliquity of the urethra leaves a transverse triangular space, with an inferior base between it and the rectum, which is filled up by the soft parts of the perineum.

The rectum is very much dilated at its inferior portion, but contracted at the anus, consisting of its proper coats above, but lined by its sphincters below.

No important artery lies between the rectum and the urinary passages, but there are several large veins coming from the seminal ducts; urinary fistulæ are also to be feared.

Rectal lithotomy is now almost entirely abandoned; we shall be brief in our description of this operation.

Methods of Sanson and Vacca Berlinghieri (Plate 79, fig. 6 and 6 *bis*).—We have already mentioned that Sanson himself abandoned his operation of rectal lithotomy through the prostate; he afterwards adopted the following method, proposed by the Italian surgeon.

The patient takes the same position, and the staff is introduced and held in the same way as in the perineal operations. The index finger of the left hand, with its pulp turned upwards towards the prostate gland, is introduced into the rectum. A straight bistoury, laid flat, is slid along its palmar surface into the rectum, about two-thirds of an inch beyond the anus.

The instrument is then turned upon its axis, so that its edge looks upwards, and its handle being depressed, its point is thrust into the intestine, and thus withdrawn, dividing the inferior part of the anterior wall of the rectum, the sphincter ani, and the soft parts of the perineum to the bulb only, exactly in the median line; the membranous portion of the urethra is thus reached, and through its walls the groove in the staff is felt, their division being effected in the usual manner. The bistoury being now carried along the groove in the staff into the bladder, the prostate is divided below and behind, in the median line. This last step of the operation is effected by depressing the handle of the bistoury, and withdrawing it in the direction of the first incisions in the soft parts.

This method holds a middle position between perineal lithotomy, and rectal lithotomy proper; it is similar to the median operation, or that of the apparatus major, and exposes the patient to but slight risks of infiltration of urine, and still less to hemorrhage; but, on the other side, the incision in the prostate is small, and to avoid wounding the ejaculatory ducts, the incision in the rectum must be as limited as possible.

Maisonneuve's method.—The patient and the staff are both in the same position as in the preceding operation. The bistoury being introduced into the rectum, about the same distance as in the last method, is used to incise its anterior wall, without, however, cutting through the sphincter. The membranous portion of the urethra is

divided, and Dupuytren's double lithotome is introduced through the dilated but uninjured anus, and with it the prostate is incised, not in the median line, but in its two posterior oblique diameters. The calculus is also extracted through the anus.

By this method the operation of lithotomy is performed through the anus, the prostate gland being divided, but the perineum and ejaculatory ducts remain uninjured. This operation has as yet been performed but in very few cases.

Much attention has been paid to a comparison of the various advantages and disadvantages of the hypogastric, perineal, and rectal operations. The size and situation of the calculi furnish indications for the choice of one or other of these operations, and also for the modifications which each of them has undergone. It would be impossible for us to give the various arguments in favor of, or against these operations. Regarding the hypogastric and rectal operations we shall give our opinions briefly; but the advocates of large and small incisions of the prostate, in the perineal operation, are so nearly balanced, that we cannot as yet consider the subject as settled. As a general principle, however, the size of the calculus ought to determine the choice between the lateral, bilateral, and quadrilateral methods. The lateral operations of Thomas and Foubert, the apparatus major with its small incisions and forced dilatation, and the median recto-perineal section, are at present almost entirely abandoned. The discussion is now only carried on between the advocates of the single section of the prostate, and those who consider two or more sections as most advisable. Accidents are more common with the first, when the incision is too extensive, or carelessly made; but they are very rare when a moderate section of the prostate only is made. The bilateral operation, although not exempt from peril, is less dangerous, and allows the more ready extraction of the calculus; these are strong arguments in favor of its more general adoption. The apparatus minor, or the incision directly upon the projection caused by the stone itself, may be sometimes well adapted to the removal of calculi in the prostate gland itself. We will conclude by saying that almost every one of these methods has something to recommend it in certain cases.

Fig. 1.

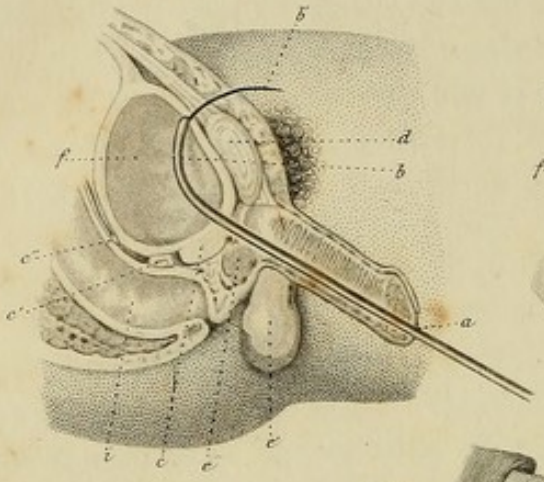


Fig. 2.

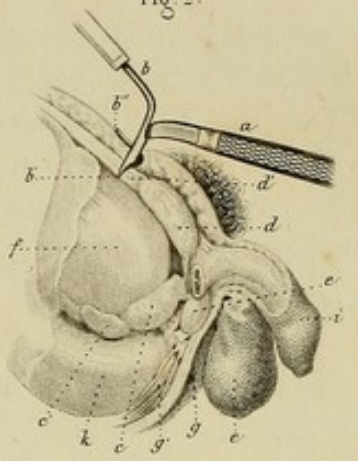


Fig. 3



Fig. 4

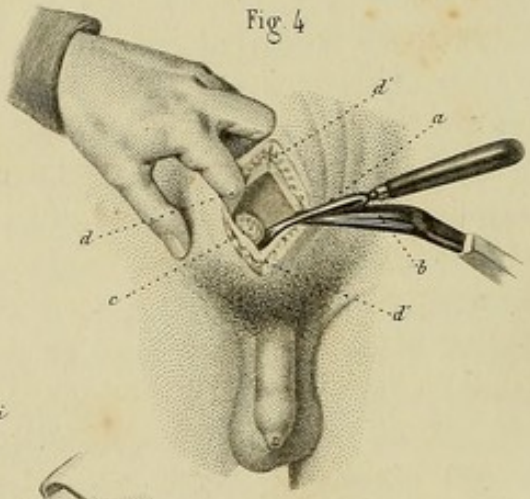


Fig. 5

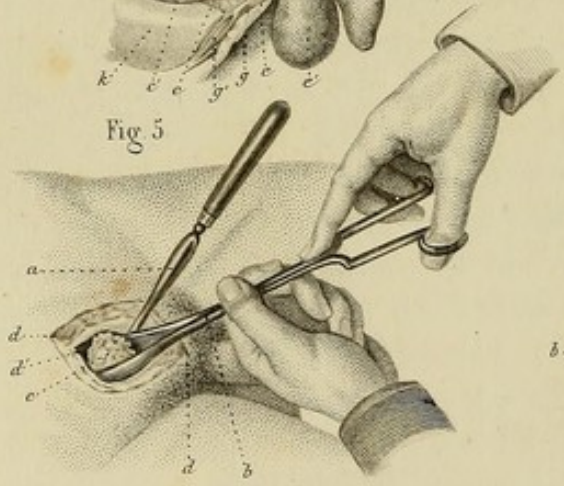
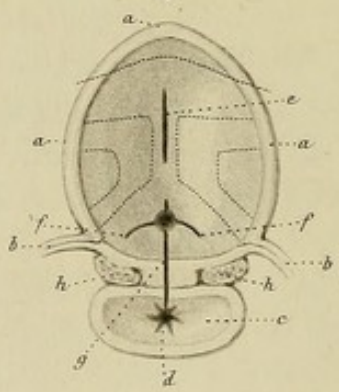


Fig. 6.



Léveillé del.

Devenne ac.

Plate LXXX.

HYPOGASTRIC LITHOTOMY.

Fig. 1. *Antero-posterior section along the median line*, showing the thickness of the perineum, and the relations of the rectum with the bladder, the prostate gland, and the urethra.—The principal object of this plate is to show the manner in which the armed sound is used.—*a*, the sound introduced into the urethra; *b*, its curved portion in the bladder, its concavity looking upwards and forwards, and its point resting against the anterior aspect of the bladder, just above the symphysis pubis; *b'*, the dart, which has been thrust out of the canula, from within outwards, through the entire thickness of the anterior wall of the bladder and abdomen; *c*, the prostate gland; *c'*, the vesiculæ seminales; *c''*, the recto-vesical peritoneal cul-de-sac; *d*, the symphysis pubis; *e*, the bulb; *e'*, the testicle; *f*, the bladder distended by fluid.

Fig. 2. *Hypogastric lithotomy, section in the linea alba.—a*, Belmas' probe-pointed bistoury, with its concavity looking downwards, is about to be carried into the small wound already made by the combined trochar and bistoury *b*; *b'*, the point of the latter instrument in contact with the bladder, having perforated the linea alba and the subjacent cellular tissue; *b''*, a small stem attached a few lines from the point of the compound trochar-bistoury, for the purpose of limiting the distance which it can be thrust into the abdominal walls, and to prevent it from entering the bladder; *c*, the prostate gland; *c'*, the vesiculæ seminales; *d*, the symphysis pubis; *d'*, extent of the incision in the linea alba to be made with the probe-pointed bistoury; *e*, the bulb; *e'*, the scrotum; *f*, the distended bladder; *g*, the anus; *g'*, the sphincter ani; *k*, the rectum.

Fig. 3. *Incision of the bladder.—a*, a straight bistoury puncturing the bladder, the instrument being introduced in a direction perpendicular to the anterior aspect of the bladder, with its edge turned

towards the symphysis, while its back rests upon the dorsum of the left index finger, which is bent so as to hold up the vesico-parietal peritoneal cul-de-sac; *b*, the point where the anterior wall of the bladder is punctured with the bistoury, and divided from above downwards, just behind the symphysis; *c*, the prostate gland; *c'*, the vesiculæ seminales; *d*, the symphysis pubis; *e*, the bulb; *e'*, the scrotum; *f*, the distended bladder; *f'*, the peritoneum covering the bladder, thrust back by the distension of the latter; *g*, the anus; *g'*, the sphincter ani; *k*, the rectum; *i*, the penis.

Fig. 4. *Dilatation of the wound.—Extraction of the stone.—a*, a curette, or elevator, introduced into the bladder along the concave portion of the blunt gorget *b*, and raising up the calculus, *c*; the lips of the wound are drawn apart transversely by means of the gorget on one side, and the left index finger *d*, bent into the form of a hook, on the other; *d' d'*, represent the superior and inferior angles of the wound made in the walls of the abdomen and bladder.

Fig. 5. *Extraction of the stone with the lithotomy forceps.—a*, the curette raising up the calculus; *b*, a pair of lithotomy forceps, with straight jaws and crossed handles, seizing the calculus, *c*, by its sides. The thumb and third finger of the right hand are passed through the rings in the handles of the forceps, while the index finger is extended down upon the branches. The left hand grasping the branches very close to the jaws, serves to steady the instrument, and assist in the traction. *d d*, the superior and inferior angles of the wound, the latter being extended into the integuments forming the mons veneris; *d'*, the lips of the wound in the bladder.

Fig. 6. *The internal aspect of the bladder*, the superior and posterior part having been removed to show the points of the organ which are interested in the various operations for lithotomy, the dotted lines indicating the position of the anterior peritoneal cul-de-sac, the two ossa pubis, and the symphysis pubis.—*a a a*, section of the walls of the bladder; *b*, the ureters and vasa deferentia; *c*, the cavity of the rectum; *d*, the anus shown in the interior of the intestine; *e*, the vertical and median wound of the hypogastric operation, made in the anterior aspect of the bladder on a level with the symphysis, and carried down as far as the middle of the posterior aspect of the latter; *f f*, the semi-lunar incision with an anterior convexity, made in the bas-fond of the bladder by the bilateral operation; this curved incision is formed by two incisions, which commence at the neck of the

bladder. A very small antero-posterior median incision, which commences at the neck of the bladder and is carried forward, represents the anterior section of the neck. *g*, antero-posterior incision in the median line, extending from the neck of the bladder to the anus, represents the section made by the recto-vesical inferior operation, and is carried along the median line through a part of the bas-fond of the bladder, the prostate gland, and the anterior wall of the rectum; *h h*, the vesiculæ seminales, situated above the prostate gland, and interposed between the rectum and the posterior aspect of the bladder.

SURGICAL ANATOMY OF THE REGION ABOVE THE PUBES.

The possibility of perforating the bladder by its anterior aspect depends upon an anatomical fact. The bladder, when empty, usually lies behind the symphysis pubis, but when distended, it rises up, and is covered by the abdominal wall; the peritoneal cul-de-sac which covers the bladder superiorly, rises up with this viscus, leaving it uncovered by peritoneum to a certain extent, and at this point it can be opened without wounding the serous membrane.

The first layer is formed by the skin, which is continuous with that of the abdomen above, the mons veneris below, and with the integument of the inguinal region on each side. This region is usually covered with hair, particularly in the man. The hair is in general most plentiful along the median line. This line may also be recognised by its more marked color, and also by a vertical depression which can be felt with the finger, when the recti muscles are contracted. In very fat persons, it can be made out, by carrying a line upwards midway between the spines of the pubis, if they can be felt, or between the anterior superior spinous processes of the ilium, or finally, by carrying a line directly downwards, from the umbilicus to the root of the penis, or to the superior commissure of the labia majora.

Immediately beneath the skin we find cellular tissue, thinner along the median line than on the sides, which can be divided into two layers. (*Superficial and deep layers of the fascia superficialis.*) The quantity of fat in the cells of this tissue, and particularly in the layer lying immediately beneath the skin, is extremely variable; at the mons veneris, it is usually greater in the female than the male, being sometimes several lines in thickness, producing a very deep wound when the hypogastric operation is performed.

The third layer is made up of the large muscles of the abdomen, their tendons, and the sheaths of the recti and pyramidales muscles; the linea alba is situated in the median line, and is formed by the interlacing of the tendons of the external and internal oblique muscles. If the abdomen be relaxed, a projection can be felt with the finger at this point, and a depression if the recti muscles be put upon the stretch. The linea alba is about a line in thickness, and varies in size in different individuals, being well-marked in women who have had children.

The recti muscles are situated on each side of the linea alba, and are covered by a strong fibrous layer. These muscles are narrower as they approach the pubes, being at this point rarely more than an inch in width, including the pyramidales, which is a small bundle of muscular fibres, not always present. They are inserted into the spines of the pubes, and all that portion of the bone lying between the spines and the symphysis. The edges of these muscles are much thinner than the central portion. To their outer side a white line is seen, being a fibrous and tendinous interstice, lying between the external borders of the afore-mentioned muscle, and the anterior terminations of the fleshy fibres of the broad muscles. These lateral white lines, *lineæ semilunares*, are much better marked below the hypogastrium.

The point where the epigastric artery reaches the internal border of the rectus muscle is too high up to be in danger of being wounded when the operation of lithotomy is performed after Drivon's method.

Behind the afore-mentioned layers, instead of the large and strong tendons of the oblique muscles (it will be recollected that the sheath of the rectus is wanting at its posterior and inferior part), we find a somewhat lamellar cellular tissue, occasionally almost tendinous in its character, and again loose and very extensible; this is the *fascia transversalis*. The character of this cellular tissue varies very much in individuals. It is important to know, that it sometimes forms several layers of unequal consistence, that it is interposed in the abdominal wall, having the posterior aspect of the pubes on one side, and on the other the peritoneum and that portion of the anterior aspect of the bladder which is uncovered by this membrane, and that it frequently adheres very strongly to the posterior aspect of the linea alba.

The urachus, in the median line, and the two fibrous cords which are the remains of the umbilical arteries, lie in this cellular layer, between the peritoneum and the recti muscles.

When the bladder is distended, this cellular layer is generally thin, but very resistant, having very much the character of the fibrous sheath of the large arteries; it is put upon the stretch just behind the recti muscles, and ought to be divided with caution, a crucial incision being made if necessary. The cellular tissue is always much looser when it lies in contact with the peritoneum or the bladder. This fact indicates the possibility of separating the peritoneum, without previously distending the bladder with an aqueous injection; it is necessary, however, to avoid too great destruction of this tissue.

We now arrive at the bladder and peritoneum. Most surgeons recommend that the bladder be distended with water before performing the hypogastric operation, in order to carry up the cul-de-sac, which the peritoneum forms at this point, as far as possible, and also to facilitate the recognition of the bladder. It is not very difficult to dissect up the peritoneum, but there is occasionally some difficulty experienced in deciding when the bladder is arrived at; the paleness of its muscular fibres, and their filamentous appearance, causing them to be confounded with the investing cellular tissue.

The bladder is usually thin, but it is sometimes hypertrophied, which condition, however, increases but very little the difficulties of extracting the calculus. If the incision be not carried too far down, there will be no danger of wounding the veins around the neck of the bladder.

MODES OF OPERATING.

The hypogastric, or high operation for stone, was first performed by Franco, but was first satisfactorily described by Rousset; it was highly recommended by some, and condemned by others of the lithomatists of the seventeenth and eighteenth centuries; frère Côme usually performed it in women; considerable attention has also been paid to it by modern surgeons. It is expedient, whenever calculi are too large to be easily extracted by the perineum, that is to say, when in an adult, the diameter of the stone is found to exceed an inch and two-thirds. It is also advantageous in children, as in them the bladder projects considerably above the pubes; and in whom also, the neck is very far up, the prostate gland small, and the perineum narrow.

A wound of the peritoneum is the most formidable accident to be apprehended. To avoid this accident, the following precautions have

been laid down: 1st. To distend the bladder before commencing the operation; 2d. To raise up with a catheter the anterior wall of this organ; 3d. To carry the peritoneum well up with the fingers, after having detached it to a sufficient extent.

Various reasons have been offered against performing this operation. Among others, it has been alleged that it is difficult, that there is great liability to infiltration of urine, and also to danger of peritonitis, either in consequence of a wound of the peritoneum itself, or owing to its proximity to the necessary opening. The latter is the best founded, and the most serious objection. It has also been remarked that the cure was slow, and that there was occasionally a fistulous passage remaining which was difficult to heal.

But if we compare this with the perineal operations, we will find that the same general objections can be made against them, while the former is never complicated by hemorrhage, false passages, lacerations of the perineum or the prostate gland, wounds of the rectum, of the vesiculæ seminales, etc., etc.

Hypogastric lithotomy appears to us to be very appropriate in cases where the ordinary operation can only be performed with difficulty; we consider it much more advisable than the vagino-vesical, or the recto-vesical operations, which frequently are productive of great annoyance.

Modes of operating.—It is altogether useless to attempt to describe the various modifications to which this operation has been subjected. We shall content ourselves with merely mentioning some of the modern methods; for instance, that of Drivon, who recommends a longitudinal incision to be made along the external border of the rectus muscle, which would render the detachment of the peritoneum both difficult and doubtful.

In Franco's method, a transverse incision was made parallel to, and at a short distance above, the superior border of the pubes. This destroys too extensively the attachment of the recti muscles. To be sure, the operation would be simplified, at least so far as the section of the bladder and the extraction of the calculus are concerned, but the wound would be much larger, and the cicatrisation of the muscles slow, if not incomplete.

Amussat's method (Plate 80, fig. 3, 4, and 5).—*Position of the patient:*—Upon the back, with the pelvis slightly raised. *Position of the surgeon:*—On the left side, so as to make his incision from

below upwards, that is to say, beginning at the pubes, from which point all incisions must be commenced.

The special instrumental apparatus consists of a curved catheter, which can be used as a director, and also for injecting the bladder, and a syringe, with a canula, which fits the catheter accurately. The surgeon should also be provided with blunt hooks, a blunt curved gorget, and a pair of lithotomy forceps, bent at a right angle, may also be found useful.

The hair being shaved off, the catheter is introduced, and the bladder is moderately distended by the injection of warm water. Amussat then withdraws the catheter, and an assistant squeezing the glans, prevents the escape of the fluid. If it be considered desirable to retain the catheter in the bladder, a plug can be inserted into its external opening, and the penis slightly pressed upon it.

The operation is now commenced by dividing the skin in the vertical direction, for about an inch in the median line, after which the sub-cutaneous layers are incised, and the linea alba brought into view, and the left index finger being carried down to it, it is then divided, and the *fascia transversalis* exposed. The surgeon now changes his position to the right side. Great caution is required in dividing this layer, so as not to wound the peritoneum. The point of the bistoury, with the edge looking upwards, is introduced just above the symphysis, and a small incision is carefully made in the fascia, which is then extended upwards with the probe-pointed bistoury, and also laterally, if the opening appears to be insufficient. The left index finger is then introduced into the wound and carried directly downwards, but not too deeply, along the median line, so as to discover the summit of the bladder. To assure himself that the bladder is really felt, Amussat advises the surgeon to introduce his right fore finger into the rectum, and by bending the two fingers towards each other, to ascertain if the bladder lies between them. This fact being determined, the bistoury, lying flat, is introduced between the finger nail and the symphysis, the point of the finger marking the place where the bladder is to be punctured; the bistoury is then thrust into the bladder, and an incision, some two-thirds of an inch long, is made, which is afterwards enlarged, if deemed advisable. There is a sudden jet of water from the bladder, which is stopped by thrusting the finger into the wound, when the shape and situation of the calculus is easily made out. The bladder is elevated by hooking the finger into the upper portion of

the wound, which is also dilated by traction upon its lips, and the forceps are introduced as soon as possible, before the fluid in the bladder has escaped. The finger is also useful in catching the stone in the most suitable way for extraction, and for detecting the presence of other calculi. If the stone be very large, the finger must be withdrawn to give room for its extraction.

A large and strong blunt hook ought to be placed in the superior angle of the wound in the bladder, to prevent the latter from escaping and sinking down into the pelvis, while the finger is employed in feeling for the calculus, or arranging it properly in the jaws of the forceps; if this be neglected, and the bladder escapes and sinks into the pelvis, the surgeon may experience some difficulty in finding the incision which he has made in the viscus.

The dressing consists in introducing a large curved canula, which is firmly fastened to the lower portion of the wound by ligatures and adhesive straps, through which the urine escapes, while an attempt is made to heal the wound above it by the first intention.

Method of Baudens (Plate 80, fig. 3, 4, and 5).—This method is less complicated than the preceding. No injection of the bladder is made, which in some cases renders the satisfactory recognition of that organ very difficult. The surgeon makes out the exact position of the symphysis, and marks with his nail the point to which he will extend the incision superiorly; the cutaneous and sub-cutaneous layers are divided down to the linea alba; the sheath of the rectus muscle is incised about the sixth of an inch to the right and outer side of this line; then laying down the bistoury, he separates the recti muscles by tearing apart with the index fingers the cellular tissue which lies between them, and in this way arrives at the anterior surface of the bladder, which is separated from the posterior aspect of the symphysis pubis in the same way. This method of proceeding shortens the operation; but it seems to us that allowing the linea alba to remain intact would have the effect of tightening the wound; the latter, however, might be easily enlarged in a lateral direction.

Having arrived at the bladder, the two fingers are bent into a hooked shape, and their nails used to detach the peritoneum, from below upwards. The anterior fibres of the bladder being fairly exposed, the peritoneum is held up with the left index finger, while the bistoury held in the right hand is used to open the organ, the same precautions being observed as in Amussat's method. The advan-

tage claimed for this method is, that the wound is not inundated by the escaping fluid. The introduction of the forceps, the extraction of the calculus, etc., etc., are the same in both methods.

These are the operations most in use for performing hypogastric lithotomy.

To prevent infiltration of urine, suture of the bladder has been proposed, and frère Côme introduced a catheter for this purpose, which was to be permanently retained.

Leroy d'Etiolles uses an instrument especially constructed for the division of the aponeurosis, in order to render the first stage of the operation more satisfactory (plate 80, fig. 2). Belmas' catheter, with the sharp-pointed stylet, is no longer used (plate 80, fig. 1).

If the calculus be very large, it may be broken into two or three pieces by means of very strong lithotrity instruments introduced through the wound.

Verniere and Vidal (de Cassis) propose to make two distinct operations of hypogastric lithotomy. The first stage consists in incising the soft parts down to the bladder, or in opening a passage by means of caustics, as has been proposed for discharging collections of fluid in the abdomen. The bladder is not to be opened until the granulations are so thoroughly developed on the edges of the wound as to prevent all possibility of the infiltration of urine. Our limits will not permit us to discuss the value of these modifications, the very few operations, however, which have been performed in this manner present no very striking advantages.

Plate LXXXI.

OPERATIONS UPON THE GENITAL ORGANS OF THE FEMALE.

LITHOTOMY IN THE FEMALE.

Fig. 1. *Anatomy of the perineal region in the female.*—C, sphincter ani; C′, constrictor vaginæ; P, the anus; V, the vagina. *s*, the clitoris; *u*, the meatus urinarius; *m m*, superficial branches of the internal pudic artery; *b*, a deeper branch of the same artery, going to the clitoris; *l l*, the transversus perinei muscles; *i i*, the middle fascia; *a a*, the internal pudic arteries; *f f*, the glutæus maximus muscles; *r*, the levator ani.

Fig. 2. *Vestibular lithotomy in the female.—Lisfranc's method.*—(1st stage of the operation).—A, a curvilinear incision made in the vestibulum, through which the calculus is to be extracted; the vestibulum is enlarged at the same time by depressing the urethra *u*, by means of the staff, S. *b b*, the fingers of an assistant holding the labia majora as far apart as possible. V, the external orifice of the vagina; *l l*, the labia minora.

Fig. 3. *Urethral lithotomy in the female*, being a profile view of the perineum, to show the relation of the different organs.—*Method of Laurent Colot.*—P, the anus; S, a director carried through the urethra into the bladder; V, the vagina; *a*, the uterus; *a′*, the orifice of the neck of the uterus; *a″*, a fold of the peritoneum coming down upon the bladder and uterus; *b*, the bladder; *c*, the vesico-vaginal septum; *d*, the recto-vaginal septum; *e*, the inferior portion of the rectum uncovered by peritoneum; *e′*, the superior portion of the rectum; *l*, the middle hemorrhoidal artery; *t*, a straight bistoury whose point *u* is inserted into the groove of the director. (See *modes of operating.*)

SURGICAL ANATOMY OF THE PERINEUM IN THE FEMALE.

In the female, as in the male, the ano-perineal region, as a whole, may be considered as a musculo-fibrous floor, destined to close the

Fig. 1

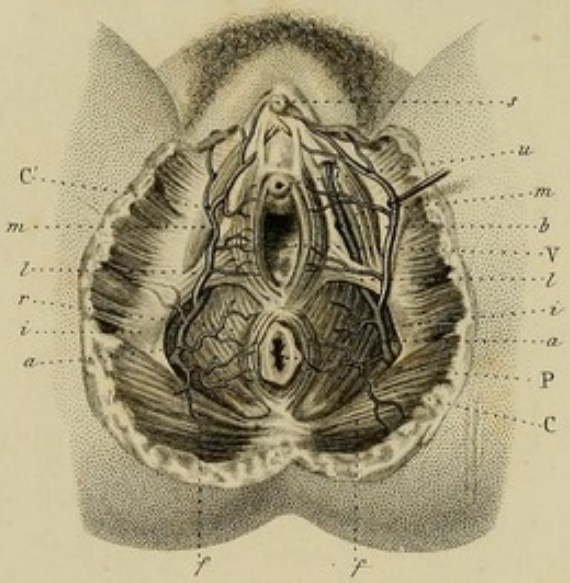


Fig. 2

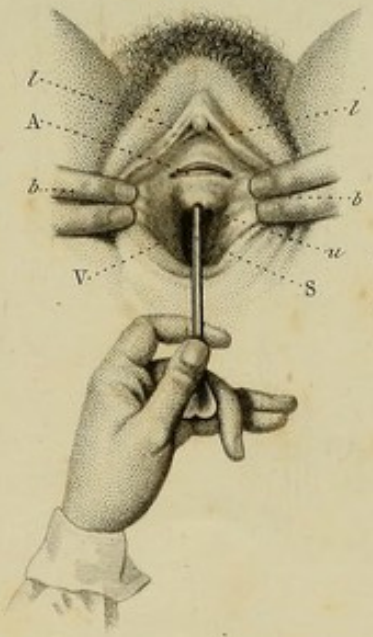
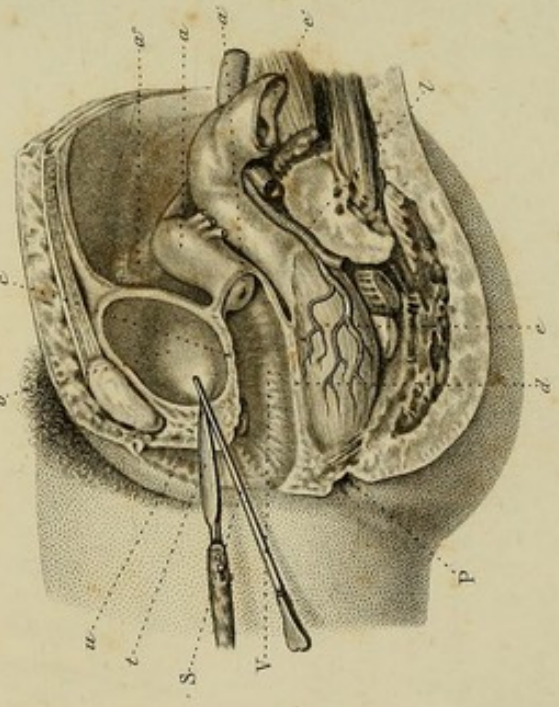


Fig. 3



inferior portion of the abdominal cavity. This floor is formed, in both sexes, upon very nearly the same planes, and arranged in the same order. The modifications depend upon the organs which pass through it. It presents two parts or regions: one, posterior or anal, the other, anterior or perineal—properly so called. In the first, the same elements are met with in both sexes; the rectum lies in the centre, surrounded and supported by the levator ani, and is terminated below by the anal orifice P, fig. 1, which is also surrounded by the sphincter ani C; on the right and left we find the ischio-rectal hollow, bounded by the obturator internus and levator ani muscles, and their aponeuroses. The internal pudic artery *a* passes through this space, which is usually filled with fat. It is more shallow in the female than the male, but has a greater extent transversely; this is explained by the increased distance between the tuberosities of the ischia, which are directed more obliquely outwards, and project less prominently. The anus itself is, therefore, more prominent, lying very nearly in the same plane as the two tuberosities, the quantity of adipose cellular tissue being less in this locality than in the male. The skin in this vicinity and that which immediately surrounds the anus, is thin and almost deprived of hair.

In front, however, in the perineal region proper, there is a very marked difference, depending not upon the arrangement of the layers, or planes, but upon the organs which pass through these layers. This portion of the perineum is traversed by a membranous canal, the vagina V, fig. 3, which lies between the rectum and bladder, and is surmounted by the uterus, whose neck it embraces, and to which it may be looked upon as an excretory duct. This canal is terminated below by the vulva. In front, it is in close relation with the urethra. The vagina and urethra pass through the superficial and middle fasciæ, whose arrangement is the same as in the male. The superior fascia presents some difference, in consequence of the absence of the prostate gland, and the increased development of the two cellular lamellæ which cover the vessels and the hypogastric nerves. We find these two lamellæ also in the male; but in the female, the presence of the vagina and the uterine vessels requires a greater development of these cellular layers, and renders them more apparent.

The vulva, or the external parts of generation, taken as a whole, presents itself externally in the form of a fissure, or cleft, extending from the mons veneris, to within an inch of the anus. The fissure is

bounded on each side by a fold of skin more or less prominent, which folds are called the labia majora. The internal faces of these folds lie in contact with each other, while the external, or cutaneous aspect, is covered with hair. The internal aspect is covered with mucous membrane, and we find in this case, as in almost all others where the internal and external integuments of orifices are continuous, that the transition from skin to mucous membrane is nearly insensible, the only distinguishing mark being a change in colour. The anterior, or superior termination of the labia majora, is continuous imperceptibly with the mons veneris. Their posterior extremity is united by a membranous fold, called the posterior commissure, or fourchette, which is usually lacerated in childbirth. They contain contractile fibrous tissue, pilose and sebaceous follicles, an expansion of the *fascia superficialis*, and of the superficial aponeuroses.

When the labia majora are separated, two other lips, consisting of erectile tissue are brought into view, which are covered by mucous membrane, and abundantly supplied with sebaceous follicles. These lips, which are smaller than the preceding, arise on each side, by a thin point, from the internal aspect of the labia majora, at about the posterior third of the vulva. They are united to each other anteriorly, at which point they cover a species of rounded nipple, which varies in size in individuals, and consists of an abundant erectile tissue, or rather of a cavernous body with two roots; this nipple-shaped body is well supplied with nerves, and is covered by a thin fibrous coat which acts as a sheath to the mucous membrane. These two folds, or lips, are called the labia minora, and their anterior commissure forms the prepuce of the small erectile nipple, or clitoris.

a a, the internal pudic arteries. Behind the posterior border of the transversus perinei, these arteries divide into two branches, one superficial *m m*, being distributed to the labia majora and the mons veneris; the other, the deep branch *b*, going to the clitoris.

Veins accompany these arteries; sometimes a portion of those coming from the clitoris communicate with the veins of the vagina. The lymphatics go to the inguinal ganglions, and the nerves take their origin from the internal pudic, and the inguinal branches of the lumbar plexus.

About five or six lines behind and below the clitoris *s*, we see the external orifice of the urethra, the meatus urinarius *u*, and one or two lines behind the meatus there is another nipple-shaped prominence,

smaller than the clitoris, which is called the urethral tubercle. This is the anterior portion, the termination of the column, or longitudinal anterior crest of the vagina, slightly reflected into the shape of a tubercle.

The space between the clitoris and meatus, which is bounded on each side by the angular separation of the labia minora, is called the vestibulum, and is interesting to the surgeon on account of its great dilatability, which allows it to be stretched to more than double its usual length (from twelve to fourteen lines), when the urethra is carried backwards, or when, as in pregnancy, and during labour, or for any other reason, the meatus is carried upwards until it lies behind the symphysis pubis.

Behind the vestibulum, and commencing at the urethral tubercle, lies the orifice of the vagina, which occupies all the posterior part of the vulva, with the exception of a small triangular space called the fossa navicularis, which separates it from the fourchette. In virgins, this orifice is partially closed by a thin membrane, sometimes arranged in the form of a diaphragm with a central opening, and sometimes of a crescentic shape, the free border looking upwards. This membrane is called the hymen; it is ruptured in coitus, and its remains form small tubercles, called carunculæ myrtiformes. The excretory duct of the vulvo-vaginal gland opens just outside of these carunculæ.

The vagina V, a short distance from its external orifice, is embraced by a spongy body which has received the name of the bulb of the vagina. The walls of this membranous canal consist of a layer of erectile tissue, of fibres of yellow, elastic, and unstriped muscular tissue, some of which are longitudinal, arranged along its anterior and posterior aspects, making two prominences in the vagina, called its columns, and others which are circular, extending from one of these columns to the other, and forming internally numerous transverse folds, by raising up the mucous membrane which lines the internal aspect of the canal. Just within the external orifice of the vagina there is a ring of true muscular fibres, the sphincter, or constrictor vaginæ C′. A large number of follicles, or minute glands, are scattered over the mucous membrane; the vulvo-vaginal gland, which lies just outside of the vagina, and whose excretory duct passes through the walls of the latter, seems to be one of these minute glands enlarged. The arteries which supply the vagina are branches of the internal iliac, and the veins, which frequently anastomose with

each other, and with those of the clitoris, empty into the internal iliac vein. The nerves are derived from the hypogastric plexus.

The anus, P, is surrounded by its sphincter C; *r*, the levator ani; *i*, the tuberosity of the ischium; *s*, the clitoris; *f f*, the glutœus maximus muscle on either side.

The female urethra, which is much shorter and less complicated than that of the male, commences at the meatus, is directed upwards and backwards, being slightly curved, the concavity looking forwards, as it passes behind the symphysis pubis, and finally terminates at the neck of the bladder. This neck, destitute of a prostate gland, is more open, and situated nearer to the most inferior portion of the body of the bladder. The urethra varies from fourteen to eighteen lines in length. In front, it is some three or four lines from the symphysis pubis, and behind, it is in immediate relation with the anterior wall of the vagina, which has a species of groove hollowed out in its substance to receive it; it leaves the vagina as it takes a direction upward, being separated from it by cellular substance, some three or four lines in thickness. This canal, which is larger than that of the male, is also susceptible of very great dilatation. The structure is the same as the male urethra.

The bladder, *b*, presents no peculiarities in the female, excepting that it rises up a little more above the symphysis pubis. Behind, it is in relation, not with the rectum, but with the vagina and uterus *a*, which is also a membranous canal, capable of very great dilatation. The vagina varies from four to five inches in length, from its external orifice to the neck of the uterus. In the natural state it is about an inch and a quarter in diameter; but when put forcibly upon the stretch, it may reach a diameter of more than three inches, particularly in its middle and superior portions, the external orifice being much more resistant. It describes a curve with the concavity looking forwards, the same as the urethra: its axis, which is oblique from above downwards, and from behind forwards, falls in front of that of the inferior strait of the pelvis. With the uterus it forms an obtuse angle, open in front.

The vagina is in relation in front with the bas-fond of the bladder, being united to all that portion which corresponds to the vesical triangle, by a filamentous cellular tissue, the peritoneum, which is doubled upon the posterior aspect of the bladder, being prevented by this tissue from coming in contact with the vagina. Behind, however,

the middle portion of the vagina lies in contact with the rectum, but further up, these two organs are separated by the peritoneum, which is reflected from the anterior aspect of the rectum upon the posterior aspect of the vagina, forming a recto-vaginal cul-de-sac, the bottom of which is only about an inch from the surface of the perineum. Below, the vagina, on account of its curved shape, is again separated from the rectum by an intervening cellular tissue; *c*, the vesico-vaginal septum; *d*, the recto-vaginal septum.

The uterus *a*, which is situated in the pelvic cavity, between the bladder and the rectum, is of an ovoid form, the larger extremity being turned upwards. The two superior thirds form the body, and the inferior third, the neck of the organ. The axis of the uterus is usually considered as simple, and oblique, from above downwards, and from before backwards. But recent research shows that in the fœtus, the child, the young girl, in fact, until the first pregnancy, the axis of the body of the uterus forms an angle with the neck, open in front, and sometimes quite acute—the body taking a direction, obliquely, from below upwards, and from before backwards, while the neck alone has the same axis as the superior strait; the body and the neck being flexed upon each other.

The body and the neck are, however, always separated by an intervening substance; the anterior and posterior faces are convex, the lateral and superior borders are also convex, and united together by two rounded angles which give attachments to the Fallopian tubes, the round ligaments, and the ligaments of the ovaries.

The walls of the vagina are attached around the uterine neck, which projects some five or six lines into the former. This portion of the neck which projects into the vagina is called the os tincæ, and the orifice of the uterus lies in its centre. The os tincæ is round and small in the female who has never been impregnated, but it is enlarged, and its orifice extended transversely after pregnancy. It varies considerably in appearance in different individuals.

The uterine orifice *a'* is the termination of a very small cavity in the neck and body of the uterus. This cavity is elliptical in shape in the neck, and triangular in the body, the very narrow orifice of the Fallopian tubes opening into the two superior angles. The cavity of the neck, and that of the body, communicate by a very narrow passage, through which instruments are passed with difficulty, usually producing acute pain.

The uterine walls are very thick, and invested externally by the peritoneum; this membrane, in front, being reflected from the posterior wall of the bladder upon the anterior aspect of the uterus, and posteriorly also it is reflected from the womb upon the rectum. Loops of intestine may be entangled in these folds, or cul-de-sacs, the posterior descending lower than the anterior, its bottom being only some six or eight lines from the insertion of the vagina. This serous membrane and its folds, which constitute the broad ligaments, are, in connection with the vagina and the round ligaments, almost the sole supports of the uterus. This organ is, therefore, very moveable, and liable to deviations and displacements. In spite of the resistance of its walls, it is capable of very great enlargement; in the normal state, it is scarcely on a level with the superior strait, but in pregnancy it frequently rises some distance above the umbilicus.

Besides the serous tunic, the uterine walls have a very thick layer of muscular fibres, which, though scarcely apparent when the organ is empty, acquire, during pregnancy, considerable development. These fibres alone constitute the principal thickness of the organ, and are lined on their internal surface by a very compact mucous membrane. The mucous membrane of the neck contains a great many muciparous follicles, whose secretion forms a product known as the *ovula nabothi.*

The uterine, from the internal iliac, and the spermatic arteries from the aorta, supply the uterus with blood. The veins which follow the course of the arteries are small in the unimpregnated state, but in pregnancy acquire a very greatly increased development. The nerves, which are few in number, are mostly derived from the hypogastric plexus, and distributed to the body and neck of the organ.

The broad ligaments formed by the folds of the peritoneum extend transversely outwards, and pass downwards as far as the superior portion of the vagina. They are subdivided into three secondary folds, which are lined by a few muscular fibres, prolongations of the muscular fibres of the uterus itself. These three folds inclose the round ligament, which is finally lost in the cellular tissue of the mons veneris; *a''* the Fallopian tube is a flexuous, very narrow tube, which opens into the abdomen by a fimbriated extremity.

The ovary, which is the essential female organ of generation, is of an oval shape, flatter behind than before, and attached to the uterus by a fibro-muscular ligament. Before puberty, the surface of the organ is smooth and glossy, but as the woman increases in age, its surface

becomes irregular, being dotted with numerous cicatrices, which correspond to the escape of the ova.

The ovary is formed of a very dense fibrous membrane, inclosed by the posterior fold of the broad ligament; the stroma of the ovary is produced by prolongations springing from the internal aspect of the fibrous membrane, and has the appearance of a fibrous net-work, in which the ova, or rather the Graafian vesicles are formed, which are succeeded by the corpora lutea.

The arteries which supply the ovaries take their origin from the aorta, and are accompanied by veins. The nerves are derived from the venal plexus.

MODES OF OPERATING.

INTRODUCTION OF THE CATHETER, AND LITHOTOMY IN THE FEMALE.

Catheterism.—The patient may either lie down, or sit upon the edge of the bed, the genital organs being either covered or exposed.

The ordinary female catheter found in surgical pocket-cases is the instrument generally used; it is usually made of silver, and very short, some five or six inches only in length. It is but very slightly curved, and being destined for a canal which is short, and nearly straight, in the great majority of cases it is carried into the bladder with great facility. The only difficulty, if it can be considered such, is in finding the external orifice. If the genital organs are exposed, of course no such difficulty can be experienced. The patient lies upon the back, with the pelvis slightly elevated, the thighs and legs flexed and separated from each other. As the operation can be easily performed with either the right or left hand, the position of the surgeon is a matter of but little consequence; the right side, however, is usually the most convenient.

Resting his left hand upon the pubes, the surgeon uses its thumb and index finger to separate the labia majora and minora, and fairly expose the vestibule and meatus. The catheter having been previously well-oiled, and held like a pen, with its concavity looking upwards, its point is inserted into the orifice of the urethra, and as soon as fairly engaged, the instrument is depressed so as to carry it easily behind the symphysis pubis, and being now slightly raised and pushed onwards in the direction of the urethra, it passes at once into the

bladder. It is advisable to place the point of the index finger upon the external orifice of the catheter, to prevent any sudden escape of the urine when the instrument is passed into the bladder.

Sometimes in old age, in pregnancy, or after delivery, or when the pelvis lies very deep in the bed, it happens that the urethra, rising up with the bladder into the pelvis, becomes very oblique, occasionally lying completely behind the symphysis pubis. In such cases, Velpeau advises the surgeon to separate the nymphæ with the thumb and middle fingers of the left hand, and with the index finger to pull up the clitoris and vestibule as far as possible, so as to depress the meatus by bringing it further forward; the instrument is then introduced by carrying it beneath the ham of the same side upon which the surgeon stands, instead of directly between the patient's thighs. If this fails, a male catheter, or an instrument very much curved, may be required.

In difficult cases, a choice of ways cannot always be granted, and the surgeon is obliged to introduce the catheter with the patient exposed; in general this is not the case; and as the natural modesty of females shrinks from exposure, the surgeon ought to be able to introduce the instrument beneath the clothes, being guided by the touch alone. The position of the orifice of the urethra can be made out by carrying the finger from before backwards, or from behind forwards.

Velpeau advises the surgeon to separate the labia with the thumb and middle finger, and to raise up the clitoris with the index finger, the nail being turned towards the meatus; by carrying the point of the catheter down the nail and over the vestibule in the median line, it can scarcely fail to enter the urethral orifice.

In the other method, the surgeon takes his position on the left of the patient, and applies the point of the left index finger with the pulp looking upward upon the posterior part of the vulva, and carries it in succession over the fourchette, the orifice of the vagina, the urethral tubercle, about a line or two from which is found the orifice of the urethra; when this is recognised, the finger is kept in contact with it, and used as a conductor for the catheter, which, guided by it, easily passes into the urethra.

Lithotomy.—The operation is very rarely performed in the female, and ought never to be undertaken except in cases of absolute necessity. There are several reasons why this operation is rare, and they depend

upon the fortunate anatomical arrangements of the female urethra; its shortness, its slight amount of curve, and especially its remarkable capacity for dilatation, which, joined to the downward inclination of the neck of the bladder, and the absence of the prostate gland, render the complete expulsion of urine very easy, and also of calculi, which, in their earliest periods of formation, are usually of a size small enough to pass through the urethra. These conditions will also allow of the extraction of calculi of considerable size, without the previous use of the knife.

The operation of lithotomy is sometimes required, and as in the male, it may be performed above, or below, the pubis, in the perineum, or in the hypogastrium. The perineal operation has some peculiarities, which are included in the three following methods:—In the first, the operation is performed through the vestibulum; in the second, through the vagina; in the third, through the urethra, by a combination of dilatation and lithotomy.

Vestibular lithotomy (plate 81, fig. 2).—The patient is placed upon her back upon the edge of the table or bed, the body occupying a position midway between the perpendicular and horizontal, and the thighs and legs are separated and flexed. One or two assistants, *b b*, are employed in holding apart the labia majora, and minora, *l l*. The surgeon takes his position between the patient's legs, and introduces the ordinary S-shaped staff, the convexity being turned upwards and looking towards the symphysis pubis, instead of downwards, as in the male. An assistant bearing moderately, from above downward, upon the staff, depresses the urethra and the vagina, V. The surgeon, with the bistoury held as a pen, in his right hand, after satisfactorily making out the arch of the pubes, then makes about a line below it the curved incision, A, the convexity looking upward, and carries it on each side about a line beyond the ramus of the pubes.

The incision should be commenced on the right side, upon a lateral line drawn through the meatus, and carried to a corresponding point upon the other side. The point of the bistoury being held a little higher than the handle, the tissues are divided with it, layer after layer, until the bladder is arrived at, when the knife is thrust into it, or its walls are incised upon the staff, or, as Lisfranc recommends, the surgeon may introduce the thumb of the left hand into the vagina, and the fore finger into the wound, and by making moderate traction upon the tissues, the incision can be made more satisfactorily. In all

cases, the wall of the bladder is divided above the neck, and the index finger of the left hand being introduced into the wound, the opening may be enlarged by making a longitudinal incision, if the surgeon wishes to avoid injuring the muscular fibres of the bladder, or transversely, as recommended by Lisfranc, if there is less fear of dividing the muscular fibres across, than of wounding the peritoneum. The incision is about two-thirds of an inch, or an inch, in length. The forceps are then introduced, and the calculus extracted.

Vesico-vaginal lithotomy.—Rousset, who first performed this operation, made an incision some thirteen or fourteen lines in length, in the septum which lies between the vagina and bladder.

The operation was also performed by Fabricius Hildanus, Méry, Ruysch, and still later by Faure, Clemot, Flaubert, and Rigal. The operation is very simple. An ordinary staff is introduced into the urethra, the convex portion looking downward, being used to depress the wall of the bladder; a blunt gorget, with the groove turned upwards, is introduced into the vagina, and its handle is depressed by an assistant, so as to bring the groove of the gorget as nearly as possible in apposition with the staff in the bladder.

A straight bistoury is now introduced an inch, or an inch and a half, into the vagina, and its point being inserted into the groove in the gorget, an incision is made from behind forwards, of the required length; care should be taken to avoid injuring the urethra.

Velpeau modifies this operation, by placing the patient on her belly, and then flexing and separating the thighs and legs.

Urethral lithotomy (plate 81, fig. 3).—The various methods of performing urethral lithotomy may be classed under two principal heads:—Where one or two lateral incisions are made in the urethra, or, where the urethra is divided, either anteriorly, or posteriorly.

If, as in the methods of Fleurant and Louis, a bilateral incision of the urethra be determined upon, the instrument invented by the latter may be used; this consists of a flattened sheath with two lateral fenestra, into which a double-edged blade is introduced—effecting the section from before backwards. The double lithotome of Fleurant, or Dupuytren, which is very similar, is better suited to the purpose. If the single lateral incision, the method first in use, be preferred, the section of the urethra is made obliquely from above downwards, and from right to left, by means of a grooved staff, along which a long straight bistoury, or the lithotome of frère Côme is slid. The lateral

incisions are now entirely abandoned; yet Dupuytren believed, and Velpeau is of the same opinion, that the bilateral operation may sometimes be the most advantageous. (Instruments, plate XXII., fig. 1 and 2.)

In the second method, an incision of the posterior wall of the urethra directly downwards, has been recommended by Malgaigne. We are not aware that this operation has been performed as yet; it partakes a little of the vesico-vaginal operation; it is, in reality, urethra-vaginal lithotomy.

The incision of the superior wall of the urethra directly upwards, sometimes attributed to A. Dubois, dates back, according to Ambrose Paré, to Laurent Collot. The operation is very simple. A director (see Plate 81, fig. 3) is introduced into the urethra, the groove looking towards the symphysis. The instrument is used, in the first place, for depressing the wall of the vagina by bearing down upon the handle; and, in the second, as a guide for a straight bistoury or a lithotome caché, with which the urethra is divided through its entire length, as well as the adjacent tissues, to the sub-pubic ligament. By this incision, an opening some nine or ten lines in length is made, which is very small, and through which only very small calculi can be extracted. The forceps being introduced and the stone seized, the surgeon would do well to bear in mind Velpeau's recommendation, which may be useful in this, as well as in all other varieties of sub-pubic lithotomy, that the handles of the forceps be depressed so that it will rest upon the inferior floor of the urethra, and the instrument turned in the direction of the axis of the inferior strait; by regarding these maxims there will be no hindrance to the extraction of the calculus, in consequence of its coming in contact with the symphysis pubis.

Hypogastric lithotomy.—There is nothing in this operation which differs from the same operation in the male.

Lithotrity.—The same may be said of lithotrity.

Summing up.—A resumé of the various operations for lithotomy in the female, would seem to condemn nearly all of them. An opening some twelve or fifteen lines in length is about as much as can be expected from any of them. Through such a narrow passage only very small calculi can be extracted, unless lithotrity, combined with dilatation of the urethra, which we are about to describe, be associated with it. In cases of very large calculi which cannot be

broken up, the high operation, or that through the vagina, must be performed. But the opening, in the vesico-vaginal operation, is not always large enough, and is frequently, at least in one case in four, followed by the formation of a vesico-vaginal fistula, even when the wound is united by suture, as recommended by Costa. The hypogastric operation remains. For, in spite of the dangers, probably exaggerated, to which it exposes the patient, when we consider that it is the only one by which a large opening can be made, and that it is the easiest to be performed in the female, in consequence of the slight elevation of the pubes, and the height to which the bladder rises above the strait, we do not hesitate to say that it is the only appropriate operation, when it is impossible to remove the stone by the natural passage, either with or without dilatation.

Dilatation of the Urethra.—The idea of extracting calculi and foreign bodies by the urethra was naturally suggested to surgeons, from the numerous cases in which the canal must have been very much distended, to allow the passage through it of large substances, even of hen's and goose eggs, if we may believe Heister, Collot, Planque and others. The dilatation may be effected either rapidly or slowly.

1st. Rapidly. The urethra is dilated, either by introducing a director, or a blunt gorget, along whose groove the finger is forcibly introduced, or by a kind of speculum with two or three valves. 2d. Slowly, by introducing every day a tent of prepared sponge, or a piece of gentian root, which is gradually increased in size. The first method is frequently so painful that the patient cannot endure it; the second, therefore, is preferable; attempts, however, must not be made to dilate the urethra too much, lest it be ruptured, or incontinence of urine be produced. Neither ought the surgeon to forget that the dilatability of the urethra diminishes as age advances.

Fig. 1

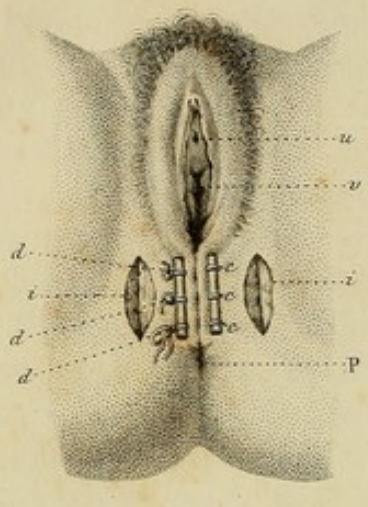


Fig. 2

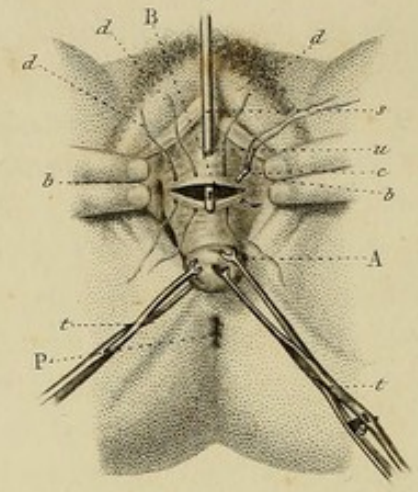


Fig. 3

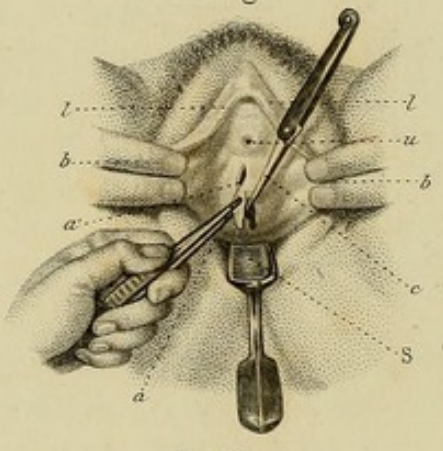


Fig. 4

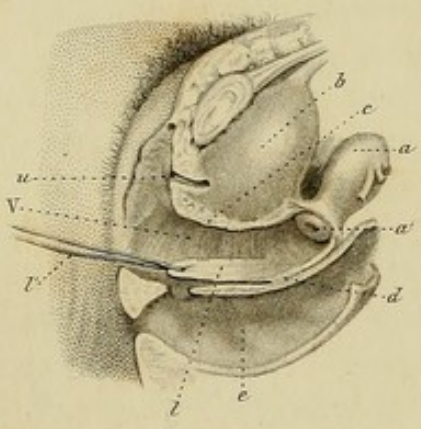


Fig. 5

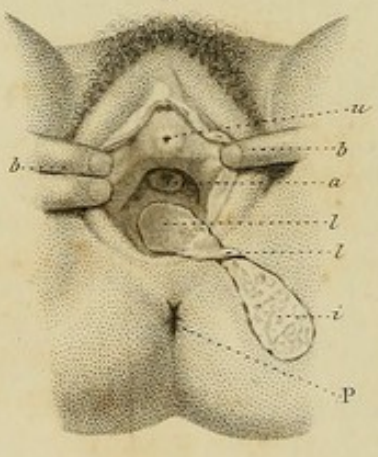


Fig. 4 bis

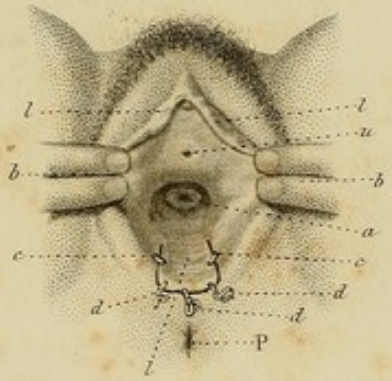


Plate LXXXII.

OPERATIONS UPON THE GENITAL APPARATUS PROPER.

OPERATIONS FOR LACERATIONS AND FISTULÆ OF THE VAGINA.

Fig. 1. This figure shows the state of the parts after the operation of perineoraphy by Dieffenbach's method, modified by substituting the quill for the twisted suture. P, the anus; *u*, the urethra; *v*, the vagina; *i i*, lateral semi-lunar incisions; *d d d*, threads tied around a quill; *c c c*, loops of thread carried around another quill.

Fig. 2. Jobert's operation for vesico-vaginal fistula, which has been called cystoplasty, by sliding the flaps; the edges of the fistula have been pared off, and the threads are being inserted. A, the neck of the uterus pulled out externally by means of Museux's forceps *t t;* B, the vesico-vaginal fistula, its edges have been pared off, and the extremity of the female catheter *s*, which has been introduced through the urethra *u* into the bladder, is protruding between them; P, the anus; *b b*, the fingers of assistants, separating the labia; *d d d*, threads already carried through the lips of the fistula; *c*, a curved needle, armed with a thread, is being carried through both lips.

Fig. 3. *Operation for vesico-vaginal fistula*, by bringing the edges of the fistula together.—*Desault's Method.*—S, an instrument used for bringing the edges of the fistula together; *l l*, the labia minora, held apart by the fingers of assistants *b b;* *u*, the meatus; *a'*, the edges of the fistula, one of which is partially cut away; *a*, a flap detached with the bistoury, *c*, is held by a pair of forceps.

Fig. 4. *An antero-posterior section*, showing the relation of the parts interested in the operation for recto-vaginal fistula.—*Jobert's Method.* —V, the vagina; *b*, the bladder; *c*, the vesico-vaginal septum; *a*, the uterus; *a'*, the neck of the uterus; *d*, the recto-vaginal septum; *e*, the rectum; *l*, the superior lip of the fistula pulled downwards by the thread *l'*, lateral incisions having been made to facilitate its descent; *u*, the meatus.

Fig. 4 *bis. A front view of the same operation.*—*l l*, the labia majora

drawn aside by the fingers of assistants *b b*; *u*, the meatus; *a*, the neck of the uterus; *c c*, points of interrupted suture; *d d d*, threads of three other points of suture; *l'*, the superior lip of the fistula drawn down and covering the opening; P, the anus.

Fig. 5. *Operations for vesico-vaginal fistula by elytroplasty.—Jobert's Method.*—P, the anus; *u*, the meatus; *b b*, the fingers of assistants holding the labia majora apart; *a*, the vesico-vaginal fistula; *l*, the flap with which it is to be covered; *i*, the wound in the thigh from whence the flap was taken; *l'*, the pedicle of the flap.

OPERATIONS UPON THE VULVA.

1st. Many of these operations differ but very little from those of the same nature which are performed in any other locality. The labia majora are frequently the seat of abscesses, which have been carefully studied, on account of the rapidity with which they are developed, the frequency of fistulæ resulting from them, the fœtid odour of the pus, analogous to that of all collections of the same nature which form in the vicinity of the orifices of natural ducts.

The only operation applicable to these cases, is that which is proper for all abscesses, incision. This incision ought to be made as much as possible on the cutaneous aspect of the abscess, as by doing so the contact of fluids escaping from the vagina with the lining membrane of the abscess is in a great measure avoided.

It is not necessary to dwell upon some other operations, which offer but little interest: such as, amputation of the clitoris, when it is hypertrophied, or the seat of a tumour of malignant character; the operation is performed either with the bistoury or scissors, the ligature being now abandoned. Excision, or the ligature, are employed for removal of the labia minora. Tumours more deeply seated, those of the vagina for instance, require a great deal of attention and caution, on the part of the surgeon. A very careful dissection is required to avoid injuring the walls of the canal in which the operation is being performed. If the recto-vaginal, or the vesico-vaginal septum, be the seat of the tumour, the introduction of the finger and catheter are useful adjuvants. If a foreign body has been introduced into the vagina, the precepts already given for the extraction of foreign bodies from the rectum are also applicable here, unless the surgeon prefers, if the foreign body is very large, to attempt to divide it, after the example

of Dupuytren, by means of a small saw introduced into the vagina, or adopting Lisfranc's method of making an incision in the perineum.

2d. *Imperforate vagina.*—The orifice of the vagina, which, in the normal virgin state, is partly closed by the hymen, is sometimes completely occluded by that membrane. This is remedied by making a small crucial incision, and excising the flaps; or, if the surgeon be without instruments, and the membrane be thin, with an accumulation of menstrual fluid behind it, he may rupture it by vigorous pressure with the finger, as already done by Malgaigne. If the septum is double, the same operation can be repeated. But imperforation of the vagina may depend upon a congenital absence of a certain portion of the canal, or upon morbid adhesions. In the latter condition, there is rarely a complete occlusion, and judiciously managed dilatation with prepared sponge, aided occasionally by slight incisions, will usually be found to answer the purpose. In the first condition, however, where the canal is wanting for a short distance only, and when, at the epoch of puberty, the menstrual fluid accumulates, and forms a fluctuating tumour, the surgeon, after acquiring an exact knowledge of the state of the case, by introducing the catheter, and inserting the finger into the rectum, may puncture the tumour with a trochar, and afterwards enlarge the artificial passage with the bistoury. If the case be one in which the vulva is grown together, with the exception of the orifice of the urethra only, we may adopt Amussat's method, and make a species of vagina by pressure with the finger, joined to dilatation with pieces of prepared sponge, and by this means gradually approximating to the existing vagina, or rather to the vaginal cul-de-sac, we may finally be able, by a simple puncture, to give exit to the accumulated fluid. In the case of a young girl of fifteen and a half years of age, Amussat commenced by pressing firmly, with a large catheter, and then with the finger, upon the mucous membrane immediately below the orifice of the urethra, at the usual point for the orifice of the vagina. In the little cavity thus formed, he firmly fastened a piece of prepared sponge. Three days after, the pressure was again renewed, causing a slight laceration of the mucous membrane; the prepared sponge was again applied. Finally, after five or six attempts, a cavity some two inches in depth was formed, at the bottom of which fluctuation was plainly felt. The index finger introduced to the bottom of the artificial canal, served as a guide for a trochar, with which the tumour was punctured, between which and the external

passage a layer of tissues about two-thirds of an inch in thickness intervened. The opening was enlarged with a probe-pointed bistoury, five-sixths of the blade being wound with linen, and the passage was afterwards kept open by means of a large catheter.

3d. *Perineoraphy* (Plate 82, fig. 1).—This name is given to an operation for curing a laceration of the perineum, whether partial or complete, and also of the recto-vaginal septum, when included in the laceration.

Laceration of the perineum, a frequent accident during delivery, may be cured by the recumbent position,—the thighs being extended and kept close together, without movement, for a proper length of time,—provided it be recent, and does not extend into the anus, or rectum. But if the laceration be of long standing, extensive, and especially if it includes a portion of the recto-vaginal septum, the edges of the wound must be pared off with the scissors or bistoury, and then kept closely in contact either with points of simple suture, or, better still, with the twisted suture, or best of all, with the quill suture, as adopted by Roux; after which, the patient must be placed upon the back, the thighs being brought together and kept in this position continually, excepting when the urine is drawn off with the catheter, which must always be used for this purpose; and when a passage from the bowels is demanded, which the surgeon must take care to have to occur as rarely and easily as possible. If, after the insertion of the sutures, there should appear to be too much drawing upon the lips of the wound, Dieffenbach's example can be followed, of making a semi-lunar incision in the skin with the convexity looking outwards, on each side of the suture. Each incision should be commenced about six lines external to the posterior border of the greater labium, and carried within about a third of an inch of the anus; the distance between the two incisions, at the point of their greatest convexity, being about two-thirds of an inch.

Whatever variety of suture be adopted, the threads should be allowed to remain until complete cicatrisation has taken place; for, in removing them before this result takes place, there may be danger of producing an entire failure of the operation, or of leaving a small fistulous passage, which is very troublesome to heal. Union by the first intention must not be counted upon.

1st. *Vesico-vaginal fistulæ.*—We cannot give an account, at length, of the various methods which have been proposed for the treatment of this painful and disgusting affection. Were we to do so, it would only serve to show the unsatisfactory character of nearly all of them. A fortunate idea, derived from the ancient practice, has been lately brought forward by Jobert, which enables us to consign to the surgical arsenal as curiosities, a great variety of instruments, no longer of use, but which will remain as testimonials of the efforts of modern surgery to cure, or relieve, a miserable condition, considered beyond the resources of science, until J. L. Petit, and Desault, followed by some of the German surgeons, again drew the attention of the profession to the subject.

The treatment of J. L. Petit was limited to the introduction of a simple plug into the fistulous passage through the vagina. This was found to be more troublesome than useful, particularly when combined with the truss which was added by Desault. Malagadi, Roux, Lallemand, and Naegelé first pared off the edges of the fistula, and then brought them together by the simple, the quill, or the loop suture Colombat uses the whip or furrier's suture for the same purpose. Lallemand, Caubet, Laugier, and others, have invented an infinite variety of forceps, hooks, etc. All of these methods and instruments are insufficient, the disease still remaining, if not augmented after their employment, or perhaps changed into another of similar character. To this class we must also add the cauterisation and obliteration of the vagina, as proposed by Vidal. To cauterise the edges of a fistula, the surgeon introduces the univalve, or Dupuytren's flute-beaked speculum into the vagina, and then applies the actual cautery, or the caustic (usually the nitrate of silver), upon the fistula when fairly exposed. The caustic is securely fastened to the extremity of the caustic holder, or held at right angles in a pair of forceps. What is the result of its application? If the fistula be very small, we may occasionally succeed in closing it; but a failure is generally the result, and instead of determining an adhesive inflammation, an eschar is produced which transforms a small opening into a large one.

Vidal adopts a species of plastic operation; he proposes to close the orifice of the vagina by paring off its edges, and then bringing

them together by means of sutures; but, as Sedillot remarks, this makes the vagina a branch of the bladder; and, admitting the success of the operation, the genital functions are also destroyed, and the woman is exposed to other accidents, for the menstrual fluid must necessarily, after flowing into the vagina, remain there, until it succeeds in escaping into the bladder, and is expelled thence through the urethra, which is the only possible issue from an organ which can never completely empty itself through such a passage. This operation has only been performed twice, and cannot, therefore, be judged by its results; the first operation failed; the patient died after the second. Judging it favorably, and admitting the obliteration of the vagina to be possible, we are forced to consider such an operation as a last resource, applicable only to cases where there is a large perforation, and to women who have passed the critical period.

We shall now proceed to describe the methods of Jobert de Lamballe: elytroplasty and cystoplasty, by sliding the flap.

Elytroplasty.—This is an anaplastic operation, which consists in closing the fistula by means of a cutaneous flap taken from the labia majora, or even from the thigh (plate 82, fig. 5).

The edges of the fistula being previously pared off, the labium of the side from which the flap is to be cut, is put upon the stretch, and a flap of the proper size is circumscribed by two incisions, which are united angularly, or by a third semi-lunar incision; this flap must be long enough not only to cover the fistula, but also to resist retraction. The flap should be dissected up, so that its pedicle, or base, will be as near as possible to the vagina. The surgeon is sometimes obliged to carry his incisions down upon the thigh to get a flap long enough to cover the fistula; great caution, however, in this respect, should be observed, particularly in fat women; for the cutaneous flap, with its cellulo-adipose tissue, may be so thick as to be difficult of introduction, and without this tissue it would be liable to gangrene.

The flap is then dissected up as far as the pedicle, which ought to be of a proper size and thickness, to enable the skin to retain its vitality. A waxed thread is now passed through the top of the flap, when it is introduced and fastened in its proper location by two points of suture. These two steps of the operation are somewhat difficult, especially if the fistula be high up in the vagina. The surgeon commences by folding the flap in the middle, then, introducing a female catheter through the urethra, he brings its extremity out at the fistula,

and passing both ends of the waxed thread through the eyes of the catheter, he withdraws the latter, and with it the thread which had been passed through its eyes. Then, drawing moderately upon the thread, and at the same time pushing the flap gently into the orifice of the vagina, and then into the vagina itself, he finally succeeds in applying it upon the fistula. To fasten it, the left index index finger is applied to one of the angles of the fistula, and serves as a conductor for a curved needle, or a needle-holder armed with a thread; the needle is thrust at once through the vesico-vaginal septum and the flap, and then brought out externally with a pair of forceps. A new thread is now inserted in the needle, and a similar suture is made in the other angle of the fistula. The necessity of introducing a suture in each angle of the fistula will at once be recognised, if it be desirable to apply the flap to its bleeding edges. In most cases, a double knot will answer the purpose of fastening the flap in its proper position, but, if necessary, a knot-tyer may be used.

The woman is laid upon a bed, and a catheter, to be permanently retained, is introduced into the bladder, with great caution, so as to avoid injuring the flap. This catheter must be carefully watched, to see that it is not stopped up or disarranged, and also that no urine escapes to wet the patient or the bed.

Six or seven days after the operation, the threads, whose ends have been allowed to remain in the vagina, will begin to loosen; the flap will gradually adhere more closely to the edges of the fistula; but to prevent all probabilities of gangrene taking place, Jobert advises the surgeon not to cut the pedicle before the fortieth day, or thereabouts.

Gerdy's operation for the same purpose, is apparently more simple, but is really more difficult of execution, as are all the methods of introducing sutures which have been devised previous to this of cystoplasty.

Gerdy dissects up the vaginal mucous membrane on each side of the fistula, then brings the bleeding edges of the two flaps together, and fastens them by sutures.

If there be too much drawing upon the flaps, incisions may be made in the mucous membrane a little distance from them.

Cystoplasty.—Jobert's second method is founded, essentially, upon the anatomical arrangement already pointed out, that is to say, upon the relations between the uterus, the bladder, and the peritoneum. It

will be remembered, that the peritoneum does not extend down so far between the bladder and uterus, as between the rectum and uterus, and, in consequence of this, that the neck of the uterus and the posterior wall of the bladder are only separated from each other by a very loose cellular tissue, which allows these two organs to be isolated for about an inch in extent. Jobert has taken advantage of this fact, to obviate the traction which might otherwise cause the threads to cut through the lips of the fistula.

This operation requires a considerable number of instruments. A cylinder of wood, with a very large deep groove, or a univalve speculum, Museux forceps, sharp and probe-pointed bistouries, curved and straight scissors, long and strong forceps, curved needles, the spear-pointed spring catheter of Lewzinski, or Deyber, threads, a female catheter, one or more syringes filled with water, and sponges fastened to rods.

The apparatus being properly arranged, the operation is commenced. The patient is laid upon her back, with her legs separated. The speculum being introduced, the surgeon uses it to depress the posterior wall of the vagina, so as to show the position of the neck of the uterus; then sliding the left index finger along the anterior wall of the vagina, he uses it as a guide for Museux's forceps, with which he seizes the sides of the neck of the uterus, if the fistula be longitudinal; but if the latter be transverse, he catches the neck before and behind, taking care, however, not to seize the anterior insertion of the vagina with the uterine neck. The forceps being firmly fixed, the speculum is withdrawn, and moderate traction is made upon the neck, so as to bring it down as much as possible. If the first pair of forceps should not prove sufficient for this purpose, others must be inserted. When the neck of the uterus has been satisfactorily depressed, a final exploration of the fistula ought to be made, either by introducing the catheter into the urethra and bringing its point out through the fistula, or by injecting the bladder.

The great advantage of this last step of the operation is to show the surgeon the exact position of the fistula. To effect this result more completely, which sometimes fails in consequence of the resistance of the uterus to all attempts to depress it, and especially to prevent the traction which would otherwise be made upon the superior lip of the fistula, the surgeon makes a transverse, semi-lunar incision, which detaches the vagina from its insertion into the neck of

the uterus; by doing so, he arrives at the cellular layer, lying between the bladder and the uterine neck, when, by a slow and careful dissection, keeping as close as possible to the anterior aspect of the neck, and even dividing its superficial fibres, if necessary, he isolates these two organs. Malgaigne, however, as a general rule, considers it better to reserve this step until the conclusion of the operation, because it is then alone that the surgeon can appreciate the amount of traction, and is therefore better able to decide upon the extent of the incision and dissection required. There are good arguments in favor of making the incision at either stage of the operation; when made as Jobert advises, it facilitates the depression of the uterus; made later, its extent can no doubt be more accurately proportioned, although, in fact, the traction, which is so much feared, does not take place immediately, but by degrees, as the inflammation which succeeds the operation becomes developed; it seems, therefore, preferable to make this incision early, especially when the uterus resists very strongly the efforts made to depress it. The dissection being made, the sponge is used to absorb the blood which escapes, or it is washed away by the current of fresh water; the surgeon now seizes the edges of the fistula, one after the other, with a pair of mouse-toothed forceps, and pares them off with a probe-pointed bistoury.

If the fistula be transverse, the surgeon ought to commence first with the posterior border, which, from its more depending position, would otherwise be masked with the blood flowing from the anterior border. The entire thickness of the vesico-vaginal septum should be pared off, and if any of the tissues are indurated, they must be entirely removed.

The points of suture are now inserted. Jobert frequently uses Deyber's spear-pointed spring canula for introducing the threads. But the management of the instrument is very complicated, and it is by no means indispensable. When the edges of the fistula are pared off, the wound is usually large enough to allow the introduction of the finger into the bladder, which can then be used to guide the needle. The surgeon ought always to prefer this method, which is much more simple, and allows him to assure himself that the needle has been carried through the entire thickness of the septum, which is sometimes very great. The needle, armed with the thread, is passed through one lip into the bladder, and then carried through the other lip, and brought out into the vagina, the same manœuvre being

repeated as often as there are points of suture to be inserted. If the obstacles are such as to require the use of the spear-pointed spring catheter, it must be introduced through the urethra into the bladder, so that its extremity can be brought in contact with one of the lips of the wound, when the spear point, armed with a thread, being sprung, it passes through the lip; one end of the thread is now disengaged, and the point being drawn back into its sheath, is again applied to the other lip, and being sprung, both ends of the thread are carried down into the vagina. By either of these methods, both lips of the fistula are included between loops of thread, the number being proportioned to the extent of the fistula (plate 82, fig. 2). The ends of the ligatures are pulled gently to bring the lips of the wound together, and then tied only moderately tight, for fear that too much constriction might produce an unusually acute inflammatory reaction, which would cause the threads to cut through the soft parts. Some traction may occasionally take place upon the anterior lip, which may be obviated by making small incisions in the mucous membrane of the vagina, parallel to the lips of the fistula.

If the operation has been thoroughly performed, and the lips of the wound well brought together, the fistulous orifice should be tight enough to prevent water, injected into the bladder, from escaping into the vagina. One end of each ligature may now be cut off close to the knot, while the other is allowed to hang down into the vagina, being so placed that it can be easily found when the threads are to be removed; Museux's forceps are then removed, the permanent catheter is introduced into the urethra, and the patient placed on her bed. Jobert usually places a plug of agaric in the vagina; but this is not indispensable. The hemorrhage is not to be feared; and if a little blood escapes, it can be easily stopped by the same means which are employed for removing the clots from the vagina; an oozing of blood can be easily stopped by a few injections of cold water.

In the course of eight or ten days, cicatrisation is far enough advanced to justify the removal of the ligatures, which is effected by depressing the uterus a second time, and, using the ends hanging down in the vagina as guides, cutting the knots and withdrawing them.

This operation has been frequently performed with success, and even failures, as some believe, do not produce an enfeebling of the urethra, which would give rise to incontinence of urine, but are really

imperfect cures, the fistula being only diminished. In such cases, cauterisation, or better still, a new suture, will sometimes effect a perfect cure.

[The text shows us all that French surgery (indeed, I may safely say, European surgery) has achieved for this very troublesome affection.

It literally amounts to nothing, because there are no broad principles of treatment laid down, and no successes demonstrated.

It is otherwise with American surgery. The labors of our countryman, Dr. J. Marion Sims,* leaves nothing to be desired in the treatment of this heretofore incurable affection.

He lays claim to originality:

1st. For the discovery of a method, by which the vagina may be thoroughly explored, and the operation easily performed.

2d. For the introduction of a new suture apparatus, which he terms the "clamp suture," and

3d. For the invention of a self-retaining catheter.

According to his method of exploring the vagina, the patient is placed on a table, on the knees, with the nates elevated, and the head and shoulders depressed. The clothing is thoroughly loosened to prevent all compression of the abdominal parietes; the knees separated six or eight inches, and the thighs at right angles with the table.

An assistant, standing on either side of the patient, lays a hand in the fold, between the glutei muscles and the thigh, the ends of the fingers extending quite to the labia majora; then, by simultaneously pulling the nates upwards and backwards, the os externum opens, the pelvic and abdominal viscera all gravitate towards the epigastric region, the air rushes into the vagina, and pressing with a weight of fifteen pounds upon the square inch, stretches this canal out to its utmost limits. To facilitate the view of the parts, a concave reflector, called the "lever speculum," is introduced, and held by the assistant on the right of the patient, in such a manner as to elevate the sphincter, support the recto-vaginal septum, and reflect light on the base of the bladder.

The "clamp suture" constitutes our countryman's second claim to originality.

* Am. Jour. Med. Sci., January, 1852.

"Sutures," says he, "all serve the same general purpose, viz.: the bringing and holding together parts to be united. They are variously named, according to circumstances—as the Interrupted, because it is solitary—the Continued, because a plurality of them are joined together—the Quilled, because of the peculiar method of securing it—and the Twisted, for a similar reason.

"The one that I use for closing vesico-vaginal fistulæ, I have termed the 'Clamp Suture,' because of its peculiar method of action. Thus, if the profession allow me to introduce a new suture apparatus by its most appropriate name, we shall then have, in general use, sutures named

"1st. According to their relation, the *Interrupted* and *Continued.*

"2d. According to the method of securing them, the *Quilled* and *Twisted*—and

"3d. According to its method of action, the *Clamp Suture.*

"As all sutures are but modifications, one of another, so is the *Clamp* a modification of the *Twisted.*"

The clamp suture is composed of small annealed silver wire, fastened to cross bars of lead after the manner of the quilled suture. The wire is drawn down to about No. 32. The clamps or cross bars, perforated at suitable distances for the passage of the wires, are very small, varying in diameter from one to two lines, according to the peculiarities of the case requiring the operation. They are made of silver or lead. Dr. Sims always uses lead, as it is easily adjusted to every case.

Properly applied, this suture never ulcerates out, having always to be removed by scissors, hook, and forceps. It lies innocuously in the tissues for an indefinite period, producing **no** irritation whatever. It is not removed under twelve or fifteen days—but remains intact, till the line of union is perfectly consolidated. If removed too soon, there is danger of the cicatrix yielding to the traction on the parts.

When the operation is completed, the patient is put to bed, and the self-retaining catheter introduced, which keeps the bladder effectually drained. She is not allowed to assume the erect posture for a fortnight, is kept on a light, unirritating diet, such as tea, crackers, toast, etc., with suitable doses of some of the various forms of opium twice in the twenty-four hours, for the purpose of insuring a constipated state of the bowels. Dr. Sims says he has often seen this constipation continued for three, and in some instances for four weeks, without any inconvenience, and that he never permits a motion from

the bowels under twelve or fifteen days, if it is possible to prevent it. He removes the catheter once a-day, and cleans it thoroughly. It is a very simple instrument. Its vesical extremity projects about an inch and a quarter into the bladder, and curves upwards behind the symphysis pubis, while the outer end has a counter-curve downwards, about half an inch below the meatus urinarius. Thus, it is a self-retaining instrument, a desideratum long sought for, but never before attained.

Dr. Sims has applied the principles of this operation successfully in bad cases of lacerated perineum, even where the laceration had extended entirely through the sphincter muscle. But, as he is preparing a monograph on this important branch of surgery, I shall leave him to give the details of this beautiful operation.

He has reported cases of vesico-vaginal fistula, successfully treated by this method, in the Amer. Med. Monthly (February and April, '54), in the New York Med. Times (May, '54), and elsewhere, all illustrating some of the peculiarities of individual cases, while the great principles of treatment are broadly laid down in his paper above alluded to.

The "clamp suture" has been successful in the hands of other American surgeons, amongst whom may be mentioned, Dr. Mussey,* of Cincinnati; Dr. Charles Bell Gibson,† of Richmond; Dr. Holmes,‡ of Mississippi; Dr. N. Bozeman,§ of Montgomery Ala.; Professor Charles A. Pope, of St. Louis, and Dr. Gurdon Buck,‖ of New York.

The uniform success attending this operation entitles us to speak of it in no measured terms; and we cannot but indulge a feeling of national pride when we compare its brilliant results with the meagre efforts of European surgery.

While on the subject of the "clamp suture," it may be profitable to mention the fact, that Dr. Sims entirely ignores silk as a suture, using the silver wire instead. Silk, he says, acts as a seton, irritating and poisoning the parts, and must be removed before union is always firm enough to resist the traction of the flaps, or co-apted edges of the wound, while silver remains *in situ*, for an indefinite period, without

* Am. Jour. Med. Sci., October, 1853.
† Stethoscope, August, 1853.
‡ N. O. Med. and Surg. Jour., November, 1853.
§ N. O. Med. and Surg. Jour., May, 1854.
‖ N. Y. Med. Times, October, 1854.

producing the least inflammation or suppuration. Like lead, it becomes, as it were, sacculated, producing no irritant or poisonous effect. Dr. S. has applied it to every conceivable purpose as a suture. Besides the affections above alluded to, he has used it with the clamp in urethral and perineal fistulæ in the male; and also, with the most perfect success in cleft palate.

He has used the interrupted silver suture in hare-lip, and lauds it particularly in all operations about the lips, nose, and eye-lids. In plastic surgery he has found the greatest advantage from the silver suture. Suffice it to say, that he recommends it in all cases, whether in amputations or in minor surgical operations. When used as an interrupted suture, the wires are placed close enough to hold the edges of the wound in exact apposition, without the slightest gaping. It matters not how many are required for this purpose; they are to be applied. The surgeon is to remember that they are, in themselves, perfectly harmless. Dr. S. informs me, that after amputation of the leg, or breast, he has often applied seventeen or eighteen silver sutures, all of which were allowed to remain twelve or fifteen days, and some a longer time; not a wire being removed till the union of the wound was complete, and the parts perfectly consolidated.

The application of such a number of sutures is a little tedious, but when it is remembered that a wound once dressed in this way gives comparatively no trouble afterwards, it must be conceded that it is a great improvement on the silk suture.—Ed.]

2d. The vagina may be the seat of two other kinds of fistulæ, which surgery attempts to cure. One of these may be a solution of continuity in the septum, between the rectum and vagina, causing a recto-vaginal fistula; in the other, a morbid communication is sometimes established, between a portion of the intestine lying above the rectum, and the vagina, constituting an entero-vaginal fistula.

Recto-vaginal fistula.—The rules which have been already laid down for the treatment of vesico-vaginal fistulæ are equally applicable to this variety of fistula; paring off the edges and bringing them together, cauterisation, and the suture, may be employed. A kind of suture, very similar to that of cystoplasty, can also be used, the edges of the fistula being pared off and brought together by points of interrupted suture; incisions may be made on each side parallel to the larger axis of the fistula. This is a new application of the rule of Celsus, Franco, and Dieffenbach. (Plate 82, fig. 4 and 4 *bis*.)

Finally, as a last resource, after a previous failure, we may adopt Saucerotte's method, who, having failed with the suture, divided the whole of the inferior portion of the recto-vaginal septum, and then performed the operation of perineoraphy.

Entero-vaginal fistula.—Surgery avails but little in the treatment of this variety of fistulæ. Two operations, by two different methods, have been tried in such cases, but both of the patients died. In the first, Roux opened the abdomen, and after trying to separate the vagina from the portion of intestine which communicated with it, he attempted to invaginate it into the portion below it. At the autopsy, it was ascertained, although there was nothing to indicate it during life, that instead of invaginating that part of the intestine in which the fistula was situated, into the inferior portion of the colon, it had been inserted into the superior portion. In the other case, Casamayor tried the following method, which is much more simple as well as less dangerous:

The operation was performed with a peculiar instrument, a sort of enterotome, similar to that of Dupuytren, consisting of two stems, articulated like a pair of forceps, about seven inches in length, each of which was provided with an oval plate, nine lines in length, by five in width. One of these stems was introduced into the vagina, and carried through the fistula, as far as the intestine above; the other was introduced by the rectum, until it was opposite the first. The two plates were thus separated from each other only by the walls of the intestine, and the rectum, which lay in contact with each other. The opposing surfaces of the plates were slightly notched, so that their hold would be more secure. The two branches being then brought together, the intestinal walls were firmly compressed. By this constriction, an attempt was made to produce a slough, which, making a communication between the two portions of intestine, would furnish a new passage for the fecal matter. It is to be regretted that an attack of pneumonia carried off the patient, and thus rendered such a well-designed operation useless.

Plate LXXXIII.

OPERATIONS FOR UTERINE POLYPI, AND PROLAPSUS UTERI.

Fig. 1. *Ligature of a polypus*—A, the polypus; *b*, a blunt gorget held by an assistant, for the purpose of separating the polypus from the wall of the vagina, and to assist the action of the Museux forceps, *d*, while at the same time it facilitates the carrying of the ligature around the pedicle by the ligature holders, *c'*, the ends of the ligature being already attached to the knot-tyer, *c*; *u*, the meatus; *b'*, the fingers of an assistant; P, the anus.

Fig. 2. *Torsion of a polypus.*—A, the polypus; B, forceps embracing the pedicle of the polypus; P, the anus; *u*, the meatus; *c*, the torsion forceps.

Fig. 3. *Excision of a polypus.*—A, the polypus; P, the anus; *l l*, the labia majora separated by the fingers of assistants, *b b'*; *u*, the meatus; *t t*, Museux's forceps drawing down the polypus, whose pedicle is already partially divided with a pair of strong scissors.

Fig. 4. *Obliteration of the vagina.*—A, the prolapsed vagina; *b*, the neck of the uterus; P, the anus; *l l*, the labia majora; *u*, the meatus; *s s*, the internal aspect of the labia majora, which have been pared off to the level of the orifice of the vagina; *c c c*, loops of thread which have been carried through the labia majora at that portion which has been pared off; *d d d*, their extremities on the opposite side.

Fig. 4 *bis. A case of prolapsus of the uterus and vagina.*—*u*, the meatus; *l l*, the labia majora; A, the vagina drawn out through the labia majora by the uterus, the neck *b* being seen externally; P, the anus.

Fig. 4 *ter. Method of Fricke, of Hamburg* (episioraphy).—*The operation concluded.*—*l l*, anterior portion of the labia majora; P, the anus; B B, quills introduced into the loops of thread, *c c c*, the extremities of which, *d d d*, are tied.

Pl. 83

Fig. 1

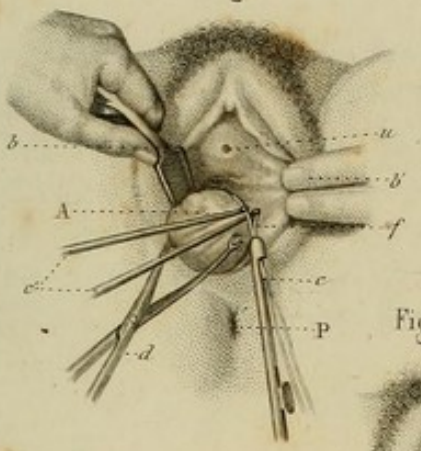


Fig. 2

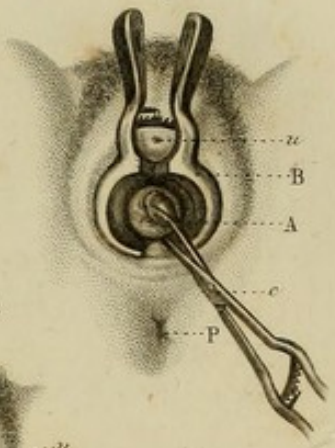


Fig. 4 bis



Fig. 3

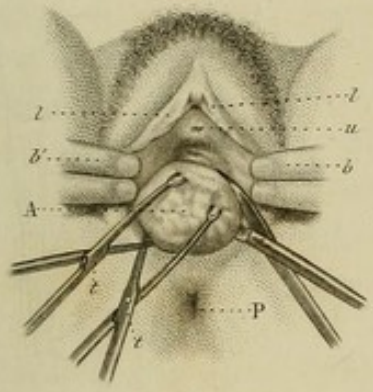


Fig. 4

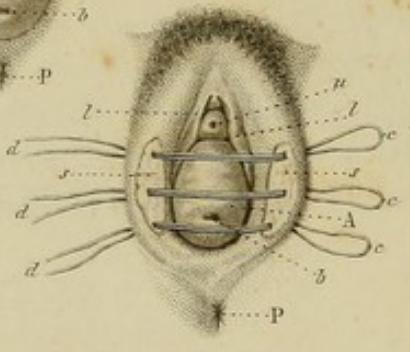


Fig. 4 ter

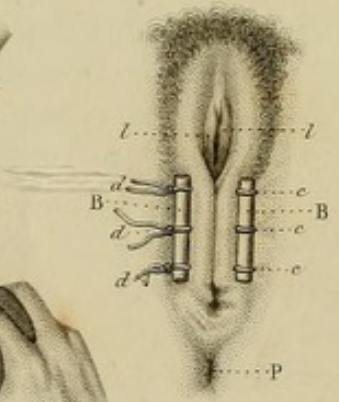


Fig. 5

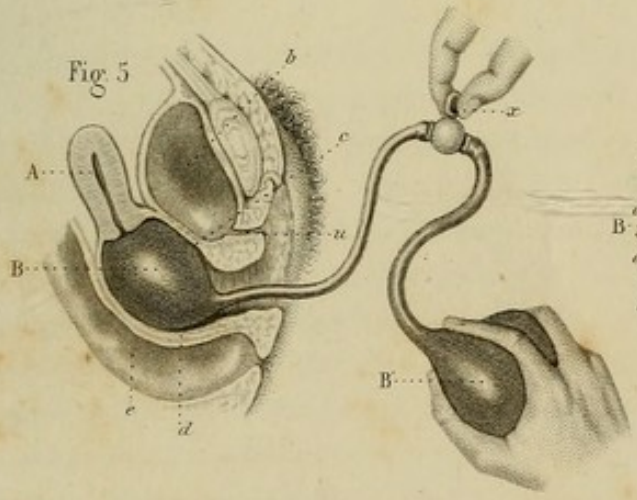


Fig. 5. *Antero-posterior median section, showing the method of applying the air pessary*—A, the uterus forced up by the globe, B, which has been introduced into the vagina; *e*, the rectum; *d*, the recto-vaginal septum; *u*, the meatus; *c*, the vagino-vesical septum; *b*, the bladder; *x*, the stop-cock, which permits or closes all communication between the vaginal globe, B, and the external globe B′, which, when compressed, empties itself and fills the other.

OPERATIONS UPON THE UTERUS.

1st. *Operations for uterine polypi.*—This is not the place for an extended pathological examination of uterine polypi; for the surgeon rarely bases his choice of operations upon their pathological state, but rather upon their consistence, volume, and the presence or absence of a pedicle. To the operator, vesicular and cellulo-vesicular polypi form but a single group; the same may be said of fibrous polypi, and those consisting of hypertrophied tissue; these details must therefore be looked for in a treatise on surgical pathology, or pathological anatomy.

MODES OF OPERATING.

There are, at least, six different methods which have been proposed for the cure of uterine polypi. Of these six methods, three are very rarely employed; their performance is very simple. They are, cauterisation, crushing, and torsion. The other methods, avulsion, the ligature, and excision, are more important.

Cauterisation was highly extolled by the ancients, but it is now almost entirely abandoned; the mode of operating is very similar to that which has been already described for cauterising the neck of the uterus; it is performed either with caustics, or the actual cautery.

Crushing.—Recamier having a case of a small and very soft polypus, introduced his finger into the neck of the uterus, and pressing the polypus between his finger and the substance of the uterine neck, succeeded in crushing and extracting it. His example might be imitated under similar circumstances. If the polypus be of large size, but soft, the surgeon may make strong compression upon it with a pair of forceps, to diminish its volume, and may, as Recamier and Dupuytren once did, succeed in destroying it almost entirely, by com-

bining pressure, crushing, and avulsion. The polypus treated in this way was very large and consistent, and could not be extracted in any other way. These surgeons tore it away in pieces, with Museux's forceps and the fingers, until the remainder was reduced to a kind of pulp which was carried off by suppuration.

Torsion.—Torsion, as well as crushing, is only a species of avulsion. The polypus being seized and put strongly on the stretch with the forceps, an attempt is made to twist its pedicle, in precisely the same way as the operation is performed for nasal polypi. If the polypus is soft, it will yield more to the traction than the torsion; but if it is hard, and the pedicle large, it resists, and in such cases it is not the polypus alone which is twisted, but the entire uterus.

Avulsion.—This method is still very imperfect, and is only performed upon polypi of a slight degree of consistence. The index finger is introduced into the vagina until it reaches the polypus, the forceps are slid along it, the polypus seized, and by combined traction and torsion, sometimes the whole, but usually only a part of it, is torn away. The operation is continued until the whole is extracted.

Malgaigne describes another method, which can be adopted when there are several polypi: it consists in pulling down the uterus with Museux's forceps, and then, with a curette introduced into the uterus, to scrape the whole of the internal surface. It is a species of crushing, and, according to the author, is not followed by hemorrhage.

Ligature (Plate 83, fig. 1).—The polypus can be tied in the cavity of the uterus, in the vagina, or outside of the vulva.

If the tumour, as well as its pedicle, be outside of the vulva, the operation is very simple, and consists in passing a strong, well-waxed ligature around the pedicle, then drawing it as tightly as possible, and tying it in a double knot. If the pedicle is not in sight, the polypus can be pulled down a little with the Museux forceps. Finally, if the pedicle be too large to be strangulated with a single ligature, a needle, armed with a double ligature, may be passed through it, and the four ends being then separated, two are tied on each side.

If the polypus, although depending beyond the cavity of the uterus, be still retained in the vagina, an attempt may be made to bring it out externally by means of the Museux forceps, when it may be treated as afore-mentioned, or a ligature may be applied to it in the vagina, with the fingers, if it is not too high up, or with one or two knot-tyers, consisting of two metallic rods, with a hole drilled in one end

of each, or terminated by claws, as recommended by Mayor, to receive the ligature; or two metallic tubes through which the cord is passed may be used. The woman is placed as for the operation of lithotomy; an assistant presses upon the hypogastrium, and the surgeon introduces the two first fingers of the left hand into the vagina, and satisfies himself of the condition of the polypus; then, resting these two fingers upon the posterior wall of the vagina, he uses them as guides for the ligature holders, and adjusts the ligature around the pedicle. The fingers are now withdrawn, and a ligature-holder being taken in each hand, they are made to describe a demi-circumference from behind forwards, which surrounds the pedicle with a loop of cord. The ligature-holders may, after Desault's method, be introduced in front, and one of them carried completely around the pedicle, while the other is held in its original position. In both methods, the ligature-holders are brought together in front and crossed, which crosses the extremities of the ligature; these instruments are then withdrawn, and the ends of the ligature are passed through Graefe's or Sauter's knot-tyer, which is then turned around several times, so as to strangulate the pedicle.

A very simple method, invented by Favrot, consists in using two canulæ, or gum-elastic catheters; a ligature doubled in the middle is used, the loop being passed through one of the catheters, and the two ends through the other, the ligature thus passing from one to the other. The two cords composing the ligature are separated from each other, so that when the catheters are passed up the vagina, one of the cords is carried behind the polypus. Each of the catheters is then made to describe a demi-circumference, which brings them both in front, when the surgeon seizes the extremities of the ligature hanging out from one of them, and makes strong traction upon them. The cord which had been separated from the other, and which, in consequence, had not been carried behind the polypus, is more strongly pulled upon, and, owing to the position of the catheters, is brought in front of the polypus, the latter being thus interposed between the two. By pulling upon the extremities of the ligature, the loop is necessarily drawn out of one of the catheters, and completely invests the polypus. The vacant catheter is now withdrawn, and a stylet being introduced into the other, the ligature is fastened to it. This method, which is easy of execution, enables the surgeon to dispense with special instruments.

3d. If the polypus is situated in the uterine cavity, the ligature is applied by means of knot-tyers. There is one difficulty however, in applying a ligature to a polypus in this situation; the liability of carrying the instruments in a wrong direction, and tying the neck of the uterus itself. This operation is frequently accompanied by severe pains, and symptoms which compel the surgeon to loosen the ligature, and even to forego its application altogether.

Excision.—This operation may be performed upon uterine polypi, either in the vagina or the uterus. The method varies but little, in whatever locality the operation may be performed. The patient is placed in the same position as in the preceding cases, and the surgeon introduces into the vagina a bivalve speculum, or the left index finger, using one or the other of them, as a guide for a pair of strong Museux forceps, with which he seizes the polypus, and brings it down as far as possible, facilitating the operation, if necessary, by the insertion of another pair of forceps a little higher up. The polypus being drawn down, so that the pedicle is brought fairly into view, the latter is excised either with the bistoury, or a pair of strong scissors curved on their flat surface (plate 83, fig. 3).

If the polypus resists all efforts at traction, and cannot be brought down, a long, blunt-pointed bistoury, curved on its flat surface, should be slid along the index finger into the vagina, where it can be used to divide the pedicle. This method ought only to be adopted for large-sized fibrous polypi; for if the polypus be small, of the vesicular or cellulo-vesicular variety, the introduction of the speculum to dilate the vagina, will bring the tumour fairly into view, and enable the surgeon to divide its pedicle with the scissors, or the bistoury.

When the polypus is situated in the uterus, an attempt may be made to bring it down in the manner already described, or, better still, Lisfranc's example may be followed, of first depressing the uterus itself, by inserting the forceps into its neck, and then pulling down the polypus. Sometimes the polypus is too large to pass through the neck, and the vulva, in which case, after Dupuytren's example, we make an incision in the neck and the perineum, or better still, adopt Chassaignac's suggestion, and diminish the size of the tumour by making two deep incisions which will allow of the removal of a large wedge-shaped piece of the polypus. This latter proceeding is the more advisable, as it has been frequently found in cases of non-pediculated polypi, that an incision through the superficial layer,

which forms a sort of envelope, has enabled the surgeon to enucleaet the tumour.

For rapidity of execution, excision deserves the preference which is now accorded to it, since it was so generally adopted by Dupuytren. Hemorrhage is the only complication to be feared, and this rarely fails to yield to the application of the most simple hemostatics, or to plugging of the vagina. The ligature, on the contrary, is a longer operation, more dangerous, producing serious inconveniences, among which we may cite the slowness with which it effects its object, the pain which it produces, the annoyance occasioned by the discharge of fetid fluids, the presence of the knot-tyers, and the necessity of frequently repeating the constriction.

OPERATIONS FOR PROLAPSUS OF THE UTERUS AND VAGINA, CYSTOCELE, AND VAGINAL RECTOCELE.

These operations are of two kinds, palliative and radical. The simple palliative treatment is effected by the application of pessaries. (See Instruments, plate XVIII.) These are of various kinds: shaped like the bung of a barrel, like an hour-glass, a thick ring with a perforation in the centre, a child's toy, called a cup and ball, etc., etc., the form varying not only according to the nature of the disease, as vaginal hernia, prolapsus of the vagina, prolapsus, or any other displacement of the uterus, but also according to the peculiar ideas of the inventors of these instruments. One of them is intended to act upon the neck of the uterus, another, upon the body of the organ, a third, upon the vagina alone, which it raises up in folds, etc. It will be readily understood that the size of the vagina, and, still more, the nature of the lesion, ought to determine the shape of the pessary to be employed. The India rubber air pessaries can also be frequently employed to great advantage, their small size allowing them to be easily introduced, when, by being dilated, they will fill up much more satisfactorily the vaginal cavity, pushing before them the folds of the vagina, or any organs which project into the canal, without any increase of their weight or consistence, and producing but a trifling inconvenience in comparison with that which is caused by nearly all others. Their action is double; by direct pressure they force the organs before them, they dilate the vagina, making its folds to disap-

pear, which also causes the organs to rise up and resume their normal position (plate 83, fig. 5).

Whatever form of pessary may be employed, the surgeon commences by oiling it thoroughly, and then, carrying it to the entrance of the vagina, he introduces it from before backwards, and from below upwards. If the pessary is larger in one direction than in the other, its largest diameter is presented to that of the vulva, being introduced first in a backward direction, as by doing so the posterior portion of the vaginal orifice and perineum are depressed, which facilitates its passage beneath the arch of the pubes. When introduced, the pessary should be placed in its appropriate position; the elytroid, which is concave on one of its faces, should have this concavity looking forwards, so as to correspond with the convexity of the symphysis. Those which are cylindrical, or of the shape of a barrel bung, should be so placed that their axes will correspond with that of the vagina; the cup-shaped, are placed so that the neck of the uterus is received into the hollowed cut; the flat pessaries, with the central perforation, are placed in an oblique position in the vagina, one face looking forwards and the other backwards, while the superior border is carried up behind the neck of the uterus. It would be impossible for us to enumerate the various positions which may be given to pessaries, without going over the entire list of inventions. The difficulty does not consist in putting these instruments in their appropriate places, but in retaining them, displacements occurring with the greatest facility, in spite of all the various kinds of apparatus which have been attached to them to prevent it. In this relation, the funnel-shaped pessaries of gum elastic, and especially the air pessaries, have a great advantage, as they will keep their proper places without the addition of any kind of apparatus.

The *radical cure*, as well as the palliative treatment, is encumbered with a great variety of methods, whose efficacy is no better established than that of a great variety of pessaries. Dieffenbach proposed the removal of some of the folds at the orifice of the vagina; Marshall, Ireland, Hemming, and Velpeau, recommend the excision of a longitudinal, or quadrilateral, flap, from the mucous membrane of the vagina; Laugier prefers a cauterisation of this mucous membrane; Malgaigne thinks that a cure would be obtained by paring off half of the edges of the vaginal orifice, both before and behind, and bringing them together by sutures.

Fricke (of Hamburgh), under the name of episioraphy, proposes an operation which consists in paring off the edges of the labia majora, and uniting them by sutures. Romain Gerardin has recourse to the extreme measure of obliterating the vagina, the same operation as performed by Vidal de Cassis for vesico-vaginal fistulæ.

All these methods are so simple as to render a detailed description unnecessary; but they are all liable to the objection of inefficiency. All of them fail in consequence of an obstacle which is almost insurmountable; this is the mucous discharge from the vagina, which prevents adhesion from taking place; and even when success seems to be complete, hope is destroyed by the reproduction of the disease.

Where pessaries are applied to prevent displacements, or prolapsus, of the vagina or uterus, it is evident that the application ought to be preceded by another small operation; the reduction of the displaced or prolapsed organ.

The reduction of the vagina requires the same manipulations as for prolapsus of the rectum, the surface of the organ being covered with a piece of linen spread with cerate, upon which pressure, from the circumference to the centre, is gently made with the fingers. The everted uterus is treated in a similar manner, the organ being enveloped by a well-oiled piece of linen, and then, if it be a case of simple prolapsus, the base is compressed so as to diminish the size of the organ, and it is carried back into its proper position; but if the organ be completely everted, the finger is applied to the most depending portion of the tumour, which is then forced upwards in the direction of the vagina.

If it be a case of uterine displacement, the fingers, the speculum, and the uterine sound, can all be used to assist the adjustment; the organ being then reduced, efforts may be made to keep it in place, by the employment of an appropriate pessary, or of Simpson's sound.

Plate LXXXIV

OPERATIONS UPON THE NECK OF THE UTERUS AND THE OVARIES.

Fig. 1. *Puncture of the uterus.*—*a*, the uterus; *b*, the bladder; c, the rectum; *d*, the index finger of the surgeon introduced into the vagina, and serving as a conductor for the trochar *d'*; *e*, the sacrum; *f*, the abdominal wall, which is being depressed; *g*, the intestines; *h*, the anus; *i*, the urethra; *l*, the orifice of the uterus.

Fig. 2. *Application of the speculum.*—*a a*, a trivalve speculum; *b*, the neck of the uterus.

Fig. 2 *bis.*—*d*, a pair of long forceps, holding a small wad of cotton *c*, for wiping off the neck of the uterus.

Fig. 3. *Cauterisation of the neck of the uterus.*—*a*, an ivory speculum; *a'*, its handle; *b*, the neck of the uterus; *c*, the cautery iron; *c'*, its handle; *d d'*, the labia majora.

Fig. 4. *Puncture of an ovarian cyst.*—*a*, the cyst; *b*, the canula of a trochar; *c*, its handle; *d*, the uterus, *e e'*, the Fallopian tubes; *f*, the healthy ovary; *g*, the bladder; *h*, the intestines.

EXPLORATION OF THE NECK OF THE UTERUS.

The touch.—Besides the palpation and auscultation of the abdominal walls, the surgeon has two other methods of direct exploration, to enable him to ascertain the different physiological, or pathological states presented by the uterus and vagina. By the touch, he obtains a knowledge of the consistence, volume, etc, of the neck and body of the uterus, and by the introduction of the speculum, all the advantages to be gained by ocular examination are superadded.

The touch may be practised with the patient either in the erect, or recumbent position.

1st. The woman standing up, with her back leaning against some solid surface, the surgeon takes his position in front of her, either sitting, or with one knee upon the floor; the left knee, if he uses the

Pl. 84

Fig. 1 bis

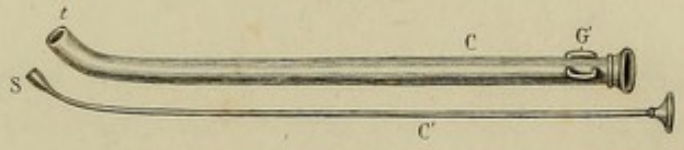


Fig 1

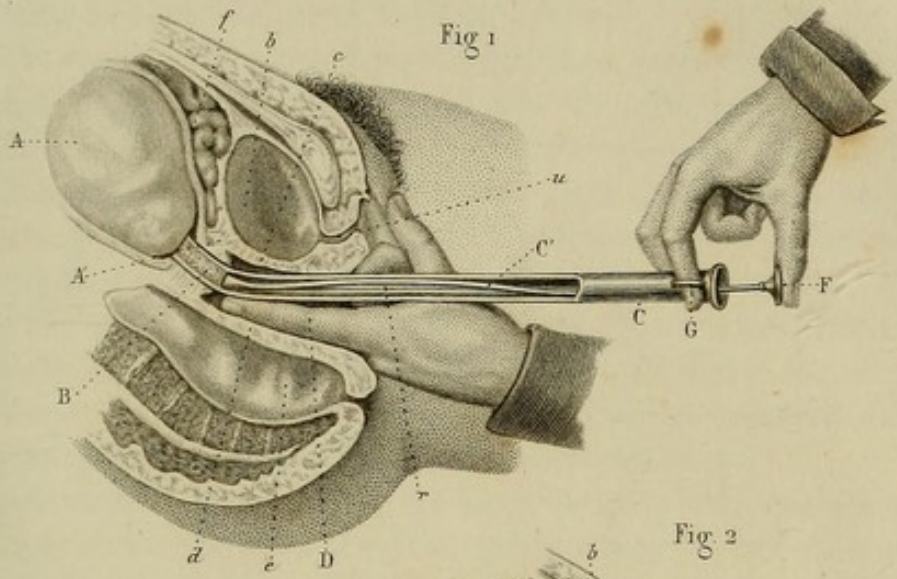


Fig. 2

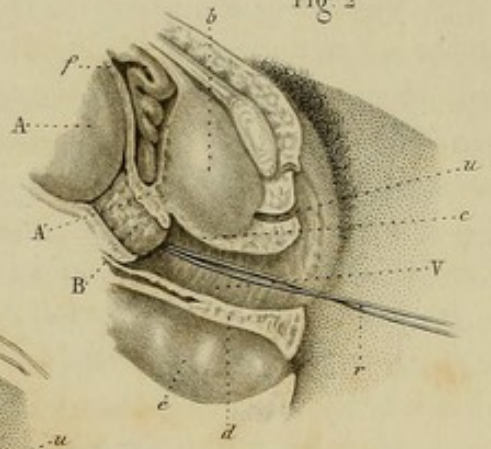
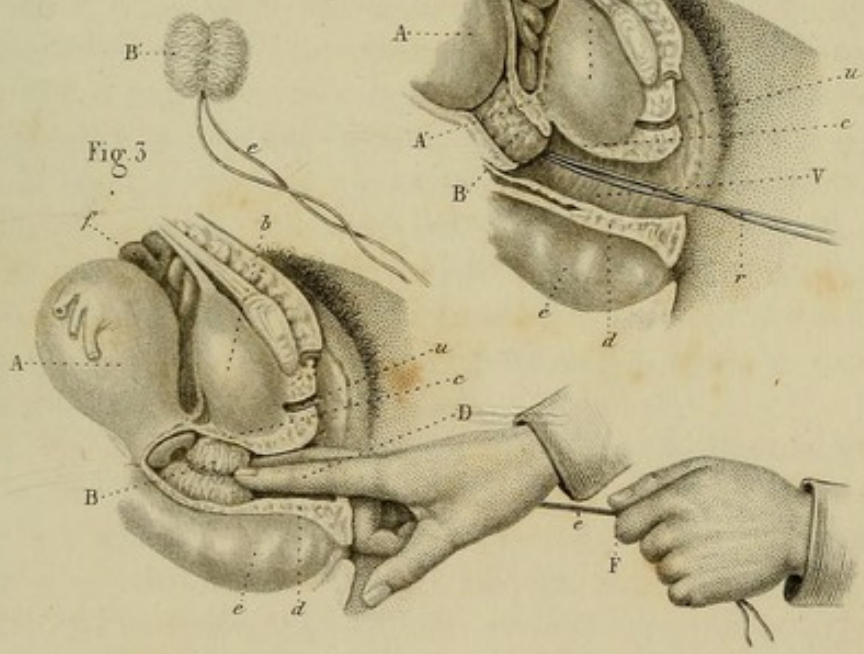


Fig. 3



right hand, and *vice versa*. Having well-oiled the index finger, he carries the hand under the clothes, the thighs of the patient being separated some little distance from each other.

Then extending the thumb and index finger, separated from each other, and flexing the other fingers upon the palm of the hand, he carries the pulp of the fore-finger backwards upon the perineum, and now bringing it forwards along the median line, until it reaches the posterior part of the labia majora, which he separates, and penetrates the vagina from below upwards, and from before backwards. The finger should be introduced gently, without force; if an obstacle is encountered, its nature should be ascertained; finally, if the woman is a virgin, the integrity of the hymen ought to be respected, unless there are positive indications requiring an examination.

After examining the vagina, the finger is brought in contact with the neck of the uterus, and carried gently around it, the os is then examined; and, to sum up, the finger is brought in contact with every part which it can reach, and the uterus itself raised, so as to ascertain its sensibility, consistence, temperature, weight, etc. Finally, to complete the examination, the surgeon places his left hand upon the hypogastrium and presses upon it, while the finger in the vagina is kept in contact with the uterus, this organ being thus, as it were, included between the two hands, which enables the surgeon to calculate its form and volume with greater certainty. This last step of the operation is performed much more satisfactorily if the woman is lying down. The operation being terminated, the nature of the fluids upon the finger is carefully examined.

2d. The woman lies down upon her back; the head, shoulders, and pelvis being slightly elevated, so as to put the walls of the abdomen in a state of complete relaxation, and the surgeon takes his position, if possible, upon the right side, carrying his hand under the clothes, and conducting the operation as in the preceding case.

Sometimes, especially if the woman is lying down, it is impossible to reach the neck of the uterus; in such cases, the pelvis must be raised up by placing a cushion, or the patient's hands, under the loins. If this does not suffice, the three fingers which are flexed may be extended, and, with the thumb applied upon the pubes, be used to force up the perineum, the middle finger, if necessary, being also introduced into the vagina.

Application of the speculum.—The surgeon will always find it

better to examine by the touch, before introducing the speculum. By so doing, he will ascertain the exact position of the neck of the uterus, and escape working in the dark, which renders the operation fatiguing, difficult, and sometimes almost impossible.

It is unnecessary to urge the employment of any one of the various forms of the instrument in use; the method of introduction varies but little, whatever variety may be preferred. It may, however, be remarked, that the smaller the inferior extremity of the instrument, the easier is its introduction; on this account, the bivalve speculum (Instruments, plate XXIV. fig. 3) appears, from its conical shape, to be the most desirable; but when once introduced, a satisfactory examination is very difficult to be obtained, the separation of the valves allowing the folds of the vagina to fall into the cavity of the speculum, and mask the parts at the bottom of the vagina. It is, therefore, better suited to the examination of the vaginal parietes.

The quadrivalve speculum (fig. 2) is very rarely used; those to which the preference is generally given, are, Recamier's slightly conical tubular pewter speculum, with the wooden plug (fig. 1), and the trivalve speculum (fig. 4).

The woman lies upon the edge of the bed, with the thighs and legs flexed, separated, and resting upon chairs, or held by assistants; the surgeon places himself in front of the patient, either sitting down, or with one knee upon the floor, and takes the well-oiled speculum, either around its superior orifice, or by its handle, the fingers resting in the concave portion, and the thumb applied upon it, just where it joins the body of the instrument, and now separating the labia majora with the left hand, he presents the extremity of the speculum to the orifice of the vagina, the handle being turned towards the pubes. The speculum ought at first to be directed from before backwards, and very slightly from below upwards, to avoid pressing upon the fourchette, which might cause acute pain. The instrument having passed through the orifice, the hand is depressed, and the further introduction of the speculum continued in the axis of the vagina. After the speculum has been carried a short distance up the vagina, the plug is removed, and the introduction continued in the direction of the neck of the uterus, whose position has been previously ascertained by the touch. The walls of the vagina can be examined as they present themselves in front of the speculum, a certain amount of force being required to overcome the resistance which they offer to its

introduction. The woman herself also makes involuntary efforts against it, the vagina contracts, and presents itself to the extremity of the instrument somewhat in the form of a rose, which may be mistaken for the neck of the uterus; but this rose-shaped appearance of the vagina is not so glossy as the neck of the uterus; it is furrowed by wrinkles, is of a deeper red colour than the neck, in the normal state, and paler when the latter is inflamed. Besides, it offers much less resistance than the uterine neck, when pressed upon either with the speculum or the sound. As soon as the neck is discovered, the surgeon attempts to inclose it in the orifice of the speculum; but, if it be too large to enter the orifice, its various parts can be examined in succession by turning the instrument in different directions, each point, as it is brought into view, being wiped off with bits of lint, or cotton, inserted into the jaws of a pair of long forceps (see plate 84, fig. 2 and 2 *bis*).

When the speculum is once introduced, the application of the actual cautery, or any topical remedies, is very simple; for the application of the actual cautery, an ivory speculum must be used, and, for topical applications, the glass cylinder speculum is the most appropriate. (Plate 84, fig. 3, represents an ivory speculum introduced into the vagina.)

When the ordinary speculum is introduced, the surgeon may also employ a similar instrument, but very much smaller, for the purpose of examining the cavity of the uterus. This very small speculum is attached to the extremity of the branches of a pair of long forceps. Artificial light is required in using this instrument, Langier's method of illumination being the most simple and satisfactory.

The speculum may also be employed when Simpson's uterine sound is introduced; but, in the majority of cases, the finger alone is sufficient guide for the instrument. The instrument for correcting obliquities of the uterus is introduced in the same way as the sound; it is unnecessary for us to dwell upon the uses of this instrument, as it is very easily introduced, and its importance has been very much exaggerated. It would seem that modern surgery has frequently attributed an influence to uterine deviations which does not belong to them, or at least only in part; although they do sometimes give rise to a chain of symptoms requiring to be carefully treated, and for which the surgeon ought to consider himself fortunate if he can discover a method of treatment which will really effect a cure.

When there is decided uterine obliquity, whether anteversion or retroversion, the reduction of the organ is the first thing to be effected. This is usually easy to do, but displacement again readily takes place. The operation is performed either by the vagina, or the rectum. The patient takes the recumbent position, and the abdomen is completely relaxed; the surgeon then introduces one, or if necessary, two fingers into the vagina, and with them forces upwards the body of the uterus, and now, hooking the extremity of the finger around the neck of the organ, he pulls it downwards.

If this fails, the fingers of the other hand, or an instrument some eight or nine inches in length, with a pellet of linen smeared with cerate on its extremity, may be introduced into the rectum, and used to push up the body of the uterus, while the finger in the vagina is attempting to pull down the neck.

Finally, if all these means fail, and the inverted womb is distended by pregnancy, the last resource is puncture of the uterus.

Puncture of the uterus.—Puncture of the uterus is performed to give exit to menstrual fluid accumulated in the uterine cavity, when there is an accidental or congenital obliteration of the neck, and also, when the impregnated uterus is in a state of retroversion which cannot be rectified. In the first condition, puncture is made by the vagina; in the second, it can also be made by the rectum.

1st. When the operation is performed by the vagina (plate 84, fig. 1) the surgeon introduces his finger, and carries it up to the point where the uterine neck and orifice ought to be found; if these cannot be recognised, he passes a slightly curved trochar, with the point drawn into its canula, along this finger, until it comes in contact with the spot where he proposes to perforate, when the trochar and canula are thrust forwards, being stopped, however, when no further resistance is offered. The trochar is now withdrawn, and the fluid evacuated through the canula, or a catheter may be introduced, and the orifice kept open, injections, if deemed desirable, being thrown through it into the uterine cavity.

2d. When the operation is performed by the rectum, the method is very similar, the trochar being introduced by the rectum, instead of the vagina; and, as in this case, the surgeon is desirous of providing a free escape for the waters of the amnion, if they do not flow out freely after the puncture, a stylet may be passed through the canula to discover the nature of the obstacle, and to enable the surgeon to ascertain if a second puncture is required.

OPERATIONS FOR CANCER OF THE NECK OF THE UTERUS.

Various operations have been proposed for cancer of the uterine neck, as cauterisation, ligature, and excision, or amputation. The ligature, which is most frequently followed by dangerous symptoms, is not entirely abandoned. Excision, which was first recommended by Recamier and Lisfranc, is, as are all other operations for cancer, followed by frequent relapses, which, added to the dangers associated with the performance of the operation itself, has now caused it to be in a great measure abandoned. Cauterisation is the only operation really worthy of preservation.

Cauterisation of the neck of the uterus, which is performed for many other lesions besides cancer, is a very simple operation. To introduce the speculum, wipe off the neck of the uterus, place a small roll of dry lint between the posterior lip and the speculum to absorb such portions of caustic as, flowing off from the neck, might otherwise come in contact with the vagina; then, with a pair of forceps, or a caustic-holder, if the agent is solid, or a camel's hair pencil, if liquid, apply the caustic to the neck, and keep it in contact with it for a length of time proportioned to the depth, or extent deemed requisite; afterwards, the application of some cold lotions sums up the whole of the operation. If the actual cautery, frequently a very useful application, is to be used, several lenticular-shaped cautery irons should be heated to a white heat, to enable the surgeon to carry the cauterisation to the desired extent; then, the ivory speculum, as recommended by Jobert, must be introduced if the surgeon entertains any fear of the metallic speculum becoming so hot during the performance of the operation as to be painful; Malgaigne, however, uses the speculum made of tin, asserting that the fears of Jobert concerning the heat are unfounded. (Plate 84, fig. 3.)

Cauterisation, especially with the hot iron, is a very useful operation; it is usually productive of but little pain, and by it the surgeon is enabled to destroy deep ulcerations, if not by one, at least after several applications, which at first sight appear to be of such a nature as to be only capable of removal by the use of the knife.

Amputation of the neck of the uterus.—There are two ways of performing this operation; one by depressing, and the other by not depressing the womb.

1st. Two fingers being introduced into the vagina, are employed to insert, and afterwards to maintain in position the jaws of a pair of Museux forceps, with which the womb is brought down to the vulva; then, with a probe-pointed bistoury, concave on the edge, curved on its flat surface, and wound with linen to within an inch and a-half of its extremity, the surgeon makes a section of the neck through the healthy tissues, a short distance above the disease.

2d. If the womb resists, and the attempts to bring it down fail, the surgeon may use advantageously a pair of long strong scissors, curved on their flat surface, or Dupuytren's curette; either of these instruments being guided to the neck of the uterus by two fingers introduced into the vagina.

The operation being concluded, and in the majority of cases this is effected without causing the patient very acute pain, unless it be during the efforts at traction, which ought to be conducted slowly and with extreme moderation, a large quantity of blood escapes, which will not require the special attention of the surgeon, unless the hemorrhage is very abundant, and sensibly weakens the patient, when plugging of the vagina must be resorted to.

Extirpation of the womb.—This operation is much more objectionable than amputation of the neck of the uterus, and ought to be abandoned. When the wound hangs outside of the vulva, tying it is a very simple operation; but the remarks already made concerning the application of the ligature to the neck of the womb, may be here repeated, unless it is immediately followed by excision.

DISEASES OF THE OVARY.

Ovarian cysts.—Special attention to the nature of the various kinds of ovarian cysts, such as the hairy, fatty, etc., is not required in a work on operative surgery. In fact, it is only applicable to one of them, known by the name of the dropsical cyst, or encysted dropsy of the ovary.

These cysts frequently acquire a considerable size, crowding the viscera, and even filling up the abdominal cavity, and distending its walls. They sometimes consist of a single fibrous sac, filled with a perfectly limpid citron-coloured serum; and again they are subdivided into a large number of cysts, which do not communicate with each other, but are inclosed in one common external envelope. This varia-

tion in the disposition of the cyst is a subject of interest to the surgeon; unfortunately, however, there is no way of ascertaining, during life, whether the sac is single or multilocular. In some cases, the cyst contracts very close adhesions with the adjacent organs; while in others, it is only attached by a pedicle, formed by the Fallopian tube, and the broad ligament, in which the arterial vessels, and particularly the ovarian artery, are found, their development being proportioned to that of the tumour.

MODES OF OPERATING.

For this disease an operation is frequently performed, which, though simple and beneficial, is yet incomplete in its results, producing only a temporary relief, and not preventing, in the majority of cases, a return of the disease. This operation is puncture of the cyst (plate 84, fig. 4). This puncture, as for ascites, is made through the abdominal walls with a trochar, the instrument being introduced into the most prominent part of the tumour, usually in the linea alba. The operation has also been performed through the vagina, but the results have not been of such a nature as to recommend renewal. Puncture being simply a palliative, is rarely useful except in unilocular cysts; it may be repeated an indefinite number of times. According to Ledran, it sometimes effects a radical cure, a result whose rarity is very much to be regretted, especially when we compare its harmlessness with the dangers sometimes provoked by other curative methods of which we are about to speak.

These curative methods are numerous, but they are all so inefficient, or dangerous, that the palliative will be the only form of treatment which the really prudent surgeon will feel inclined to adopt, at least in the earlier stages of the disease. We shall, therefore, be brief in our description of these methods.

We shall merely mention the following: compression, by Bricheteau, by means of a strongly laced band around the abdomen; puncture with a cataract needle, proposed by Maisonneuve, with the intention of producing an effusion of the fluid into the peritoneal cavity; a method which was fortunately ineffectual, as it might produce a dangerous attack of peritonitis; puncture, the canula being permanently retained to allow the continual escape of the fluid, an operation which has proved successful in South Carolina; but which

proved less successful when performed by Robert than in the hands of the American surgeon Douglas, the patient's life being endangered by an attack of hectic fever. Some cases have been cured by incision, as performed by Ledran and Galenzowski. This operation is very simple, and consists of a large longitudinal incision through the integuments, and the walls of the cyst, made either in the linea alba, or just external to the recti muscles. Through this opening exit is given to the fluid, and a roll of linen, a tent, or a canula, is introduced into the wound, as recommended by Ledran; or, a ligature being passed through the walls of the cyst, the latter is drawn up and fastened to the external wound, the cure being completed by suppuration; or a considerable portion of the cyst may be excised.

There is but a step from this operation to that of the complete extirpation of the tumour; the latter operation has therefore been performed.

Theden described a method for performing, but seems to have had no opportunity of putting it in practice. It may be that he was aware that it is very rare to find a cyst entirely external to the peritoneum, and perfectly free from adhesions, as might be imagined from his description.

More fortunate than Theden, the English and American surgeons, as is usually their custom, have not remained among the last to try an operation, which is daring, to say the least, and they have been sometimes fortunate enough to see their boldness crowned with success.

Macdowell made an incision from the umbilicus to the pubes, and his successors have very generally come to the conclusion, that the large incision is less dangerous than the small one, and have carried their incision from the xiphoid cartilage to the pubes. The incision is carried down to the peritoneum, when this membrane is seized with the forceps and raised up, while a small slit is made in it large enough to allow of the introduction of the finger which is employed to force back and protect the adjacent organs, and also serves as a conductor for a probe-pointed bistoury with which the opening in the serous membrane is enlarged. The surgeon now introduces one or two fingers, or even the entire hand, through the wound, to ascertain the nature and number of the adhesions (and, it is painful to say it), it may happen after making so extensive a wound, that he is compelled to renounce the conclusion of the operation, when the adhesions are

so strong and extensive, that all attempt to destroy them is out of the question. In such cases, the sac is emptied, and the operation limited to a simple excision. When the adhesions are few, a ligature is passed around them, and they are then divided. The cyst being isolated, is now opened, to give exit to the fluid, and a strong ligature being carried around the pedicle, the tumour is removed.

Finally, among the curative methods, there is one upon whose value the future will ultimately decide; it is puncture, followed by an injection of iodine. As yet, we can neither approve nor condemn it; for if Robert and some other surgeons have been completely successful with it in some cases, it must not be forgotten that it has failed in the hands of Velpeau and others, and that in one operation performed by Malgaigne, it gave rise to such severe symptoms that the life of the patient was seriously compromised.

Plate LXXXV.

OPERATIONS FOR THE INDUCTION OF PREMATURE LABOUR.

Fig. 1. *Dilatation of the neck of the uterus.—Usual method.—Anatomy.*—A, the uterus; A′, the neck of the uterus into which is introduced the extremity of a catheter containing the cylinder of prepared sponge B; D, the surgeon's left index finger introduced into the vagina; *b*, the bladder; *c*, the vesico-vaginal septum; *d*, the recto-vaginal septum; *e*, the rectum.

Surgeon's left hand G, is pushing into the interior of the catheter C, the stylet C′ F, whose extremity is forcing the plug B into the neck of the uterus; *u*, the meatus; *f*, loops of intestine; *r*, the cavity of the catheter or canula.

Fig. 1 *bis. The catheter and its stylet.*

Fig. 2. A, the uterus; A′, the vesico-vaginal septum. The sponge plug B, as it swells, dilates the neck of the uterus; *r*, a double thread attached to the sponge for the purpose of withdrawing it; *f*, loops of intestine; *b*, the bladder; *u*, the meatus; *c*, the vesico-vaginal septum; V, the vagina.

Fig. 3. *Plugging of the vagina.*—A, the uterus; B, a plug of lint introduced into the vagina, and being pushed up by the surgeon with two fingers of his right hand, D, as far as the neck of the uterus; the left hand, F, holds outside of the vagina the double thread, *e*, which is attached to the plug; *f*, loops of intestine; *b*, the bladder; *u*, the meatus; *c*, the vesico-vaginal septum; *d*, the recto-vaginal septum; *e*, the rectum.

MODES OF OPERATING.

Perforation of the membranes.—This operation, which was practised by Macaulay, in 1756, may be performed either with a straight or

Fig. 1



Fig. 2 bis



Fig. 2

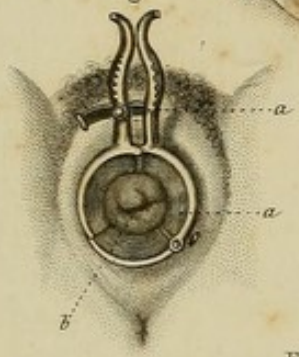


Fig. 3

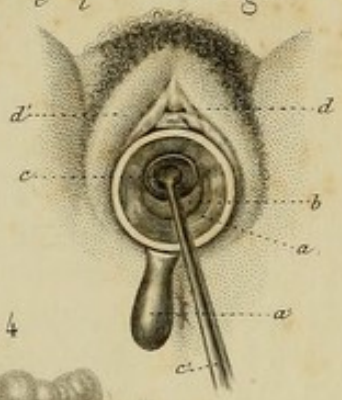
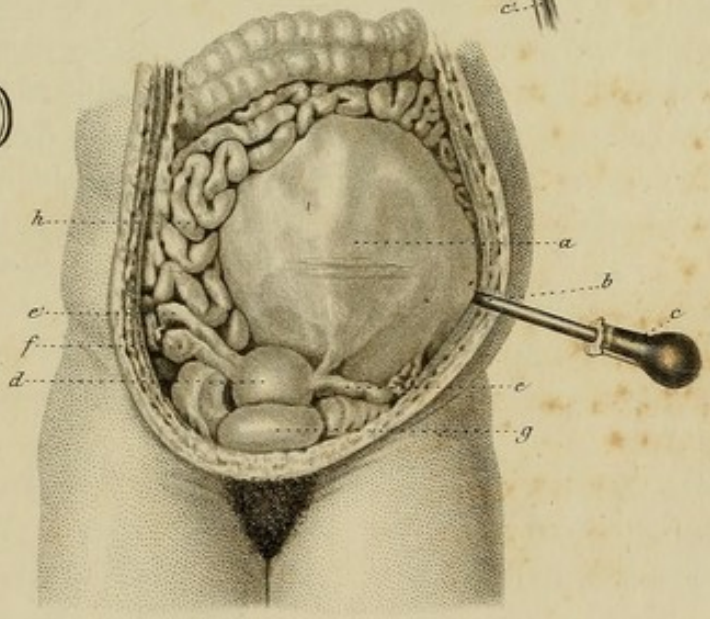


Fig. 4



curved trochar, which must, however, be long enough to penetrate the interior of the neck, and reach the inferior segment of the membranes. The instrument must be directed in such a manner as to injure neither the mother nor the fœtus.

After puncture, the rapid escape of the amniotic fluid is followed by contractions, and expulsive pains.

This method may be dangerous for both mother and fœtus. After the entire escape of the fluid, labour may be long in commencing, and progress tediously. In such cases, the walls of the uterus compress the fœtus and cause its death.

Meissner's method.—To moderate the escape of the amniotic fluid, and prevent the bad consequences sometimes resulting from it, Meissner (of Leipzig) proposes to perforate the membranes at the upper part of the ovum. The operation is performed with a silver canula, eleven inches in length, its curve representing an arc with a radius of seven inches; the instrument is provided with two stylets, one is terminated by a small ivory button, to facilitate the introduction, while the other has a trochar attached to its extremity, with which the puncture is made. The canula is introduced between the membranes and the posterior wall of the uterus. When it has been carried some nine inches above the neck of the uterus, the trochar is inserted in the place of the stylet with the ivory extremity, and the puncture is made. The fluid escapes gradually; the pains commence in due course of time; dilatation begins before the fœtus is compressed by the uterine contraction, and delivery is effected in from thirty-six to forty-eight hours.

Plugging of the vagina (Plate 85, fig. 3).—Schoeller, of Berlin, plugs the vagina for the purpose of provoking premature labour. The method of performance is the same for all purposes for which the operation is employed.

The rectum and bladder are first emptied, and then several rolls of lint dipped in oil, or cerate, are introduced to the further extremity of the vagina, the first having a double thread attached to it to facilitate its extraction (fig. 3, B′, *e*).

It is not necessary to fill up the entire vagina; inconvenience might be occasioned by doing so, difficulty being experienced in voiding the urine and fœces. The result of this treatment is soon shown by the pain in the loins and abdomen, and a sense of tension in the uterus. When the plug has provoked contraction of the uterus, and the orifice

begins to dilate, it may be removed. If labour is not established, and the pains grow weaker, and at greater intervals, the plug must be re-inserted. The pains may also be stimulated by dilating the orifice with the finger. Care should be taken not to rupture the membranes before the dilatation is nearly complete.

Dilatation of the neck of the uterus.—Kluge first suggested the idea of inducing premature labour, by the introduction of a foreign body into the neck of the uterus, which acts at the same time as an irritant, and a mechanical dilator; in order to provoke expulsive contractions, he introduced into the neck a cone of prepared sponge, with a pair of long forceps, and then inserted a plug to keep the sponge in position; the latter, by its dilatation, provoked contractions.

Ordinary method (plate 85, fig. 1 and 2).—A small cylinder of prepared sponge, with a thread passed through it, is inserted into a canula (fig. 1 *bis*); the index and medius fingers of the left hand are then introduced into the vagina, and the exact position of the neck ascertained; the canula is now slid along their palmar aspect as far as the orifice of the neck, into which the extremity of the instrument is inserted, when, by pushing upon the stylet, the sponge is forced into the neck, and the canula withdrawn.

The dilatation of this first sponge produces pains which soon cease; the neck, being somewhat dilated, will now easily receive a second sponge cylinder, whose diameter is larger than the first; the dilatation of the neck increases, new pains are produced, and if the labour does not proceed regularly, a third, and still larger piece of sponge may be introduced, when the neck will be still more dilated, and labour no doubt commenced.

Method by injections into the uterus.—Cohen gives the following description of this operation:

Take a small pewter syringe of the capacity of two or three ounces, the canula being from seven to eight inches in length, and two lines and a-half in diameter at the point, and curved very much like a female catheter, and fill it with tar water. Place the patient on her back, with the pelvis elevated, then introduce the fingers up to the posterior lip of the os, and use them to direct the canula, which is carried between the anterior wall of the uterus and the ovum, to the depth of about two inches. The injection is now made slowly and gently, the syringe being raised up a little to prevent its opening from being applied to the wall of the uterus, the direction of the instru-

ment being changed whenever there is any obstacle to the exit of the fluid. The syringe is now slowly withdrawn, and, ten minutes after, the woman may be permitted to rise and walk about. If there are no signs of labour in the course of six hours, the injection may be repeated. This simple method, which has succeeded in several cases, is worthy of attention; experience will show whether it is constantly successful as well as harmless.*

* Within the last few years Professor Kiwisch has applied the principle of the douche to the induction of premature labour. The form of the instrument used is not material, provided that a stream of water be directed steadily against and within the os uteri. Perhaps the best plan is to inject the water at the temperature most agreeable to the patient, though the result has not seemed to be greatly influenced thereby; while warm and cold water have been injected alternately. It is important that the nozzle of the syringe should be so directed, by one or more fingers in the vagina, that the stream should pass within the os. A gallon or more should be injected at a time; and the operation should be repeated in six hours, if necessary. In some cases, two or three days may be required, though the length of time can scarcely be weighed against the increased safety to mother and child.

This is the method of inducing premature labour preferred by Professor Simpson of Edinburgh. It was first employed in this city by his former pupil, Dr. George T. Elliot, Assistant Professor of Obstetrics, College Phys. and Surg., who has also found the douche of warm water of signal benefit in rigidity of the os in natural labour.—Ed.

Plate LXXXVI.

CÆSARIAN OPERATION—SYMPHYSIOTOMY.

Fig. 1. *Trunk of a pregnant female.—a a'*, a line showing the direction of the lateral incision; *b b'*, a line showing the direction of the incision in the median line.

Fig. 2. *Cæsarian operation, performed in the linea alba.—a*, head of the child; *b b'*, the incision; *c c'*, the hands of the surgeon; *d*, a protruding flap of the membranes.

Fig. 3. *Lateral incision.*—Extraction of the child by the feet.—*a*, the body of the child; *a a'*, the incision; *c*, the hand of an assistant, pulling aside one lip of the wound; *d c'*, the hands of the surgeon.

Fig. 4. *Dotted lines showing the direction of the os pubis.—a*, an incision made on a line with the symphysis pubis; *b b'*, the labia majora.

CÆSARIAN OPERATION.

(*Fig.* 1, 2, *and* 3.)

When the natural passages are too narrow to permit the introduction of the forceps, or the performance of symphysiotomy, recourse must be had to the Cæsarian operation, which consists in making an incision through the walls of the abdomen, and those of the uterus, by which the child can be extracted.

This operation may be performed upon the deceased female, from five to twenty minutes after death, with a chance of saving the child, after the seventh month of pregnancy.

Upon the living female, the Cæsarian operation is considered indispensable, when the greatest diameter of the pelvis is not more than one inch and two-thirds. The most favourable time for performing the operation is that which immediately precedes, or follows, the rupture of the membranes.

Pl. 86

Fig. 1

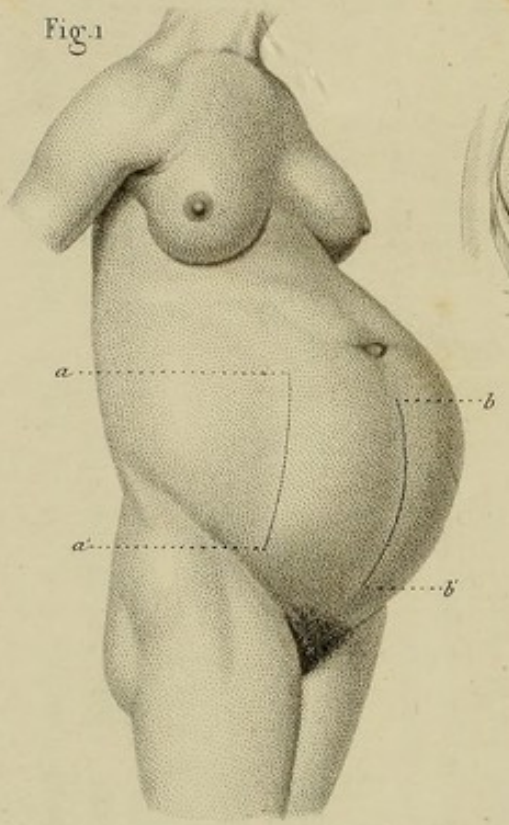


Fig. 3

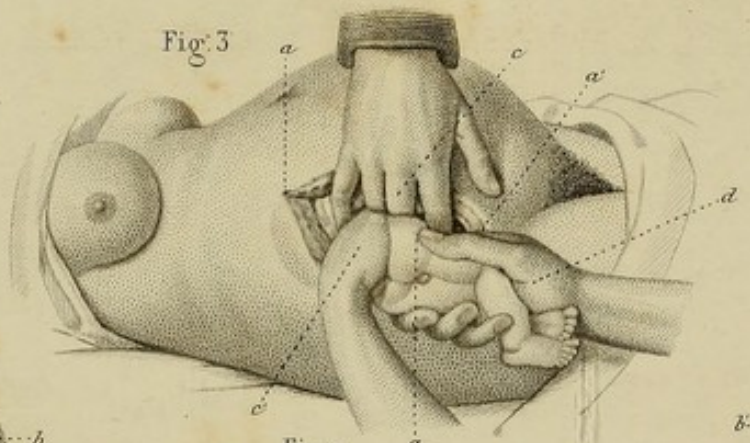


Fig. 2

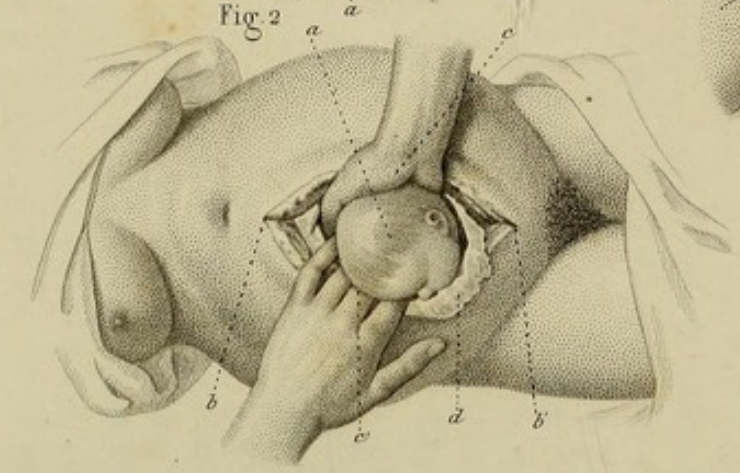
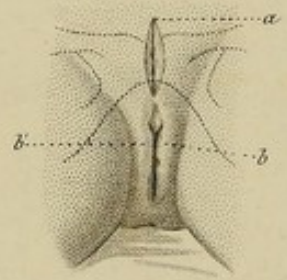


Fig. 4



The lateral incision, *a a'*, fig. 1, may be made in the right side, in the course of a line drawn from the anterior superior spinous process of the ilium to the last rib. The operation in this locality has been recommended, to avoid injuring the recti muscles. But Malgaigne very properly remarks, that authors have confounded the arrangement of the abdominal walls at the full term of pregnancy, with their condition in the unimpregnated state. At the full term of pregnancy, the linea alba is generally from three to four inches in width at the umbilicus; the lateral muscles aiding least of all the enlargement of the abdomen. Therefore, the longitudinal incision in the linea alba ought to be preferred. If the oblique incision is practised, Malgaigne recommends that it be made on a level with, and about an inch and two-thirds to the outer side of the umbilicus, terminating below, in the median line.

The *incision in the linea alba* should commence just below the umbilicus, and be carried to within an inch, or an inch and a half, of the pubes. The bladder and rectum ought to be emptied before commencing the operation. A proper number of assistants support the patient upon the bed, while another keeps the uterus as stationary as possible, by applying both hands upon the sides of the abdomen. The surgeon then makes an incision, which should be, at least, from four and a half, to five and a half inches in length, and carried through the skin and sub-cutaneous tissue only; the tendinous layers are now divided, layer by layer, down to the peritoneum, into which an opening is cautiously made, just large enough to permit the introduction of a finger, upon whose palmar aspect a probe-pointed bistoury is introduced to enlarge the incision. The uterus is then incised layer by layer, and the membranes divided with a probe-pointed bistoury in the same way as the peritoneum. An assistant keeps the lips of the abdominal wound in close relation with those of the uterus, and the child is extracted by whatever part presents, fig. 2 and 3, and afterwards the placenta.

Injections are then made into the vagina to carry away the clots; the arterial branches, if there are any requiring it, are tied, and the lips of the abdominal wound are brought together by the twisted suture.

The *transverse incision* is made between the linea alba and the vertebral column, on a level with the fundus of the uterus.

Another method has been proposed, in the intention of avoiding a wound of the peritoneum. Physick recommended a transverse incision just above the pubes, the peritoneum then to be detached and the uterus to be opened on a level with the point of detachment of the peritoneum. This method has been modified in various ways. The value of this operation has not as yet been approved by experience, and the incision through the linea alba is generally preferred.

SYMPHYSIOTOMY.

This operation was first proposed and performed by Sigault, in 1768, the result being an increase of from four to seven lines in the antero-posterior diameter of the superior strait, a separation of the bones of the pubes to the extent of two-thirds of an inch, or an inch, being also allowed. This operation may therefore be indicated in cases where the diameters of the pelvis are too small to permit the passage of the fœtal head. Yet, in the actual state of science, it cannot be considered a really practicable operation; the indications for its performance are vague and uncertain; the operation is dangerous; and the induction of premature labour is fortunately applicable to cases which might otherwise require symphysiotomy. In forty operations, Baudelocque reports fourteen deaths; thirteen children only being alive, and most of the patients being rendered infirm.

Although these returns offer but slight encouragement, we will describe the mode of operating.

Ordinary method (fig. 4).—An incision commencing a little above the pubes, is made directly in front of the symphysis, and prolonged as far as, but a little to one side of, the clitoris, so as to avoid injuring either of its crura. This first incision is carried through all the soft parts. The inter-pubic ligament is then incised cautiously, to avoid wounding the bladder, and when its section is completed, the bones immediately separate. The delivery is now terminated naturally, or by the application of the forceps, according to the nature of the case.

Imbert and Stoltz have proposed a sub-cutaneous method. The first introduces a bistoury beneath the skin, on a level with the clitoris,

and divides the symphysis from before backwards; the second divides the bone itself, to one side of the symphysis, with the chain saw.

Gabbiati has also performed a double section of the pubes.

We will not dwell longer upon this operation, whose indications, as we have already mentioned, are not clearly laid down, and whose results are very uncertain.

Plate LXXXVII.

TENOTOMY.

TORTICOLLIS, OR WRY NECK, SECTION OF THE STERNO-CLEIDO-MASTOID MUSCLE.—DISTORTED HAND, PERMANENT CONTRACTION OF THE FINGERS.

Fig. 1. *Torticollis, to the right side*, caused by the contraction of the sternal portion of the sterno-cleido-mastoid muscle.—*a*, a cord-like prominence caused by the tension and contraction of the muscle.

Fig. 2. *Torticollis to the left side*, being operated upon by the subcutaneous section.—*a*, the sternal fasciculus of the muscle upon the stretch; *b*, a wound made at a certain distance from the external border of the fasciculus, by the tenotomy knife, whose course beneath the skin is represented by the dotted line.

Fig. 3. *Tenotomy knives.*—*b*, a simple, sharp-pointed convex tenotomy knife; *c*, Jules Guerin's tenotomy knife, with two distinct cutting portions connected together by a blunt stem.

Fig. 4. *An operation for torticollis*, caused by the simultaneous contraction of both fasciculi of the muscle. The figure shows the position of the assistant, who rotates the head to increase the tension, and projection of the contracted muscle.—*a*, the point where the tenotomy knife is to come out through the skin, indicated by the extremity of the left index finger; *c*, the point where the instrument is introduced.

Fig. 5. *The same operation; second step.*—The transfixion is effected; the second cutting edge, shown by the dotted line, is being carried behind the contracted portion.

Fig. 6. *Permanent contraction of the fingers*, with palmar distortion of the hand.

TORTICOLLIS.—SECTION OF THE STERNO-CLEIDO-MASTOIDEUS.

Torticollis signifies a lateral deviation or twist of the head and neck, with an inclination towards the shoulder. The face is turned

Fig. 1.



Fig. 2



Fig. 3

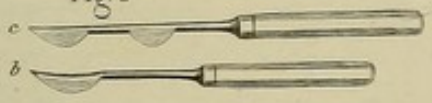


Fig. 5



Fig. 4



Fig. 6



to the side opposite the lesion. The mastoid process is carried forwards, and drawn down towards the clavicle; the cervical portion of the vertebral column is flexed laterally upon the dorsal portion. This deformity may be either temporary or permanent, and is due to various causes; it may be caused by a traumatic, or organic affection of the cervical vertebræ, by the presence of a large tumour, by the existence of bridles, cicatrices, etc., etc. It usually depends upon a contraction of the lateral muscles of the neck: the scaleni, the platisma myoides, or the sterno-cleido-mastoideus. The latter muscle, being generally the part principally affected in permanent torticollis, or at least its contraction being the sole cause for which tenotomy is performed, we shall direct our attention to it alone.

For a long time attempts have been made to cure wry-neck by means of various kinds of apparatus; but, the section of the contracted muscle is now considered the only efficacious mode of treatment; bandages and machines are looked upon only as adjuvants, although it must be acknowledged that the mechanical treatment is indispensable to obtain a cure after the performance of the operation.

SURGICAL ANATOMY.

Bouvier, Malgaigne, and others, have proposed a section of the sterno-cleido-mastoideus at different points, but their suggestions have not been adopted, the muscle being generally divided in the tendinous portion of its inferior third.

The muscle, at its inferior termination, consists of two distinct fasciculi, the internal, being half an inch in width, very firm, and fibrous for about an inch; it arises from the superior, anterior, and lateral parts of the superior portion of the sternum, in front, and to the inner side of the sterno-clavicular articulation; its most internal fibres are frequently in close proximity to those of the same muscle of the opposite side. The second, or external fasciculus, is broader, flatter, and thinner, with shorter tendinous fibres, and arises from the anterior border of the clavicle, to the extent of about two-thirds of an inch, or an inch in the adult. Sometimes the two tendons are closely in contact, and almost confounded with each other, and again, in other cases, especially in very thin subjects, they are isolated, their separation being easily recognised both by the sight and touch; a depression marks the cellular interstice which separates them.

Jules Guerin, who has clearly pointed out the functional independence of the two heads of this muscle, has also discovered that the lesion is usually to be attributed to the sternal fasciculus; the contraction of the clavicular portion, which is very rare, generally produces a lateral inclination of the head upon the shoulder, without rotation or elevation of the latter. He has, therefore, recommended the section of the internal fasciculus only, which we do not consider as warrantable.

The following are the relations of the tendons. They are subcutaneous, and form, in consequence of the contraction and tension of the muscles, a prominence in the shape of a hard, inextensible cord; no important organ lies between them and the skin; and, for this reason, the older surgeons, Tulpius, Job of Meckren, and others, made a section by cutting directly down upon them. Behind, however, a fascia alone separates the muscle from the carotid artery, and the internal jugular vein, which lie just behind the cellular interstice which separates the two fasciculi. But the tension of the muscle increases its distance from these important vessels, thus placing them beyond the probability of danger in performing the operation. The inferior thyroid, and the anterior jugular veins pass along the internal border of the sternal head, the first being separated from it by the sterno-thyroid and sterno-hyoid muscles; and the second, when present, is superficial, and can be easily avoided. The external jugular vein is generally too distant from the clavicular portion to be in danger of being wounded. The nearer we approach the points of insertion into the bones, the less the danger of wounding the vessels; in doubtful cases, therefore, the section of the tendons should be quite near to the sternum or clavicle.

There is no important nerve to be encountered in this circumscribed region; the muscle is surrounded by an aponeurotic sheath which may be destroyed, or preserved, according to the nature of the case.

MODES OF OPERATING.

The instrumental apparatus consists of tenotomy knives of various shapes: sharp-pointed for making the puncture, and blunt-pointed for the section of the muscle, some surgeons recommending them to be made concave, and others convex; a single instrument such as is

shown in plate 87, fig. 3 *b*, answers for all the steps of the operation. Jules Guerin, however, has invented a tenotomy knife with two distinct cutting edges, but this instrument is only used in exceptional cases (fig. 3 *c*). Dupuytren was the first surgeon who made a subcutaneous section of the sterno-cleido-mastoid muscle; his example was followed by Stromeyer and Bouvier; but Jules Guerin has systematised the operation, and to him the following rules, which are now generally adopted, are due.

The patient is either seated, or laid upon the back, with the trunk elevated; an assistant, stationed behind, holds the head firmly, and rotates it in the direction opposite to its usual position, so as to put the contracted muscle as much upon the stretch as possible, causing it to project so much that it can be seized through the integuments with the fingers of the left hand. This circumstance materially facilitates the section. The surgeon, in front of the patient, takes up a vertical fold of the integuments, parallel to the axis of the muscle, whose base corresponds to the point of skin which covers its external border when in a state of relaxation, and then plunges into the base of this fold, about eight or nine lines from the sternum, or clavicle, a sharp-pointed concave or convex tenotomy knife, whose blade is about two lines in width. The instrument, with its back looking downwards, and its edge upwards, is carried from without inwards, between the skin and the muscle, as far as, or even a little beyond, the internal border of the sternal fasciculus, avoiding, however, a perforation of the skin; the instrument is now rotated upon its axis, so as to bring the edge in contact with the anterior aspect of the tendon, and the fold of skin being dropped, the fibrous tissue is slowly divided by a sawing motion, a peculiar noise, a species of crackling, indicates its division, when the tenotomy knife is withdrawn.

If both fasciculi of the muscle are contracted, the surgeon immediately, through the same wound, operates upon the clavicular portion, after making it project by bending the patient's head to the opposite side; in this case, the knife makes the section from within outwards, following, however, the same rules as before; the instrument must be carried but very little beyond the external border of the muscle, for fear of wounding the external jugular vein. It is not altogether decided whether it is preferable to make the section of the muscle from behind forwards, or from before backwards; in the last method, there is less risk of wounding the vessel, but there is also greater

probability of an incomplete division of the fibrous fasciculi. Malgaigne recommends the section from before backwards of the clavicular portion, on account of the jugular vein, and the division of the sternal portion from behind forwards, because the operation is more easily performed. With regard to the latter, Guerin gives distinctly opposite advice.

By proper attention the muscle may be divided equally well in either direction. If the surgeon fears wounding the vessels, prudence requires him to use a blunt-pointed tenotomy knife, after the puncture of the skin is effected.

Another method of Jules Guerin, using the tenotomy knife with the two distinct cutting edges.—The patient being placed as in the preceding operation, the surgeon applies the middle finger of the left hand upon the internal border of the sternal fasciculus, and endeavours to insinuate it behind this portion of the muscle, so as to separate it as much as possible from the parts beneath, and also to serve as a guide for the point of the instrument; the tenotomy knife with the cutting edges, being held in the right hand, in the same way as a pen, is now thrust through the skin at the external border of the clavicular fasciculus (fig. 4), and carried behind the muscle until it encounters the end of the middle finger, which is then removed, and the point of the instrument thrust from within outwards through the integument.

The transfixion being effected, the second blade is brought opposite the fasciculus which the surgeon proposes to divide, and the handle being rotated, so as to bring the edge in contact with it, the section is made by pressing the instrument from behind forwards, and then withdrawing it. Both insertions of the muscle can thus be divided in succession, and if a few fibres escape uncut, they are divided by the blade which terminates the instrument, as the latter is withdrawn.

The objection to this method is, that it makes two wounds; it is rarely employed, the ordinary operation being preferred in the majority of cases.

PERMANENT CONTRACTION OF THE FINGERS; SECTION OF THE BRIDLES, THE PALMAR FASCIA, AND THE FLEXOR TENDONS.

The permanent contraction of the fingers may be either congenital or accidental, being sometimes produced by wounds, burns, or a peculiar disease of the palmar fascia. In all cases, these lesions may

be simple, and limited to superficial parts, or they may be accompanied by deformity of the whole hand, and complicated by contractions and defective cicatrices of the tendons of the muscles of the fore-arm.

Various methods have been proposed for treating the cutaneous bridles and the contraction of the palmar fascia.

Sir Astley Cooper was the first to adopt the sub-cutaneous method in this locality. The bridle was put upon the stretch by a forced straightening of the finger, and a narrow-bladed bistoury being thrust beneath the skin, the bridle was divided without making a section of the integuments. If the finger cannot be straightened entirely, the incision is carried a little further in the same way as before. The fingers are then kept in the straight position by an appropriate apparatus. Dupuytren operated by cutting down directly upon the contraction. The hand being supinated, and the fingers put as much upon the stretch as possible, he made an incision opposite the meta-carpo-phalangeal articulation, a little above or a little below, according to the nature of the case, or rather, we should say, directly down upon the most prominent portion of the projection which retained the finger in its flexed position. The integuments being divided transversely for about an inch, the fibrous bridle was exposed and entirely divided; a section was also made a little above, or just below this point; if the straightening was found to be still imperfect, the hand was fastened, each finger separately, to a splint applied to its dorsal aspect, and the wound dressed in with lint. Cicatrisation takes place at all the incised points, but the deformity is frequently reproduced in the course of time.

Goyrand incises the skin longitudinally over the most prominent portion of the bridle; he then dissects up each lip of the division, thus laying bare the entire length of the bridle, which he now divides at several points, or extirpates it entirely, and brings the edges of the wound together.

When the contraction of the fingers depends upon the flexor tendons, surgeons have recommended that they be divided opposite the first phalanx, others in the palm of the hand, and others still at the wrist. Lively discussions have been had upon this point of practice, which is not yet settled. Most surgeons reject the operation altogether, because tendons thus divided opposite their synovial capules, do not again unite; straightening of the fingers is obtained, but also

an almost complete destruction of the flexor motions. Tenotomy of the fingers ought, therefore, to be very rarely performed.

Contraction of the flexor tendons is the most frequent cause of this deformity, yet it may be produced by the muscles of the fore-arm which are inserted into the carpus. The subcutaneous section of their tendons is then indicated; there is no difficulty in performing the operation.

Pl. 88

Fig. 1



Fig. 3

Fig. 5.



Fig. 2



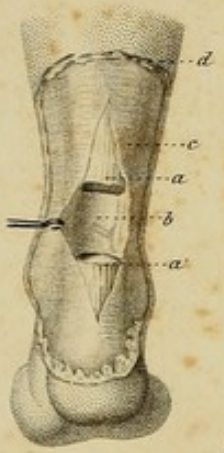


Fig. 4

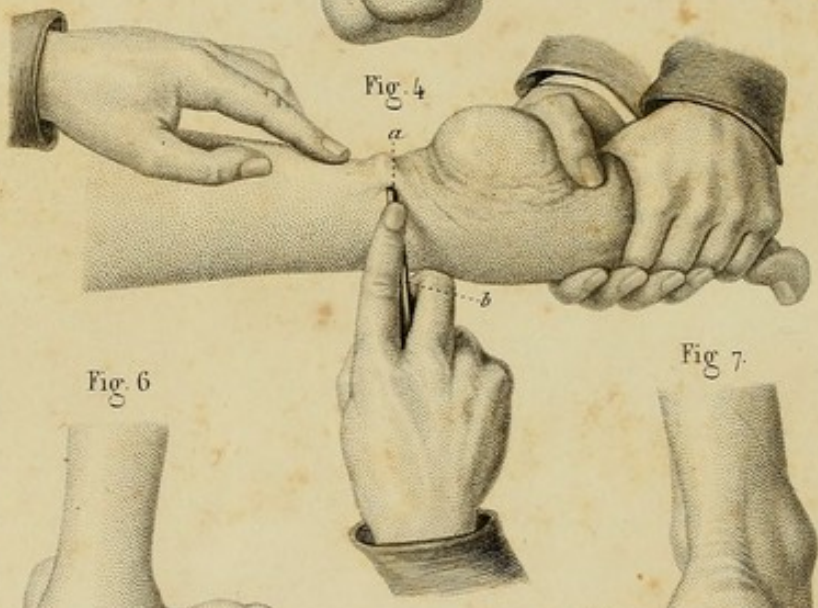


Fig. 6

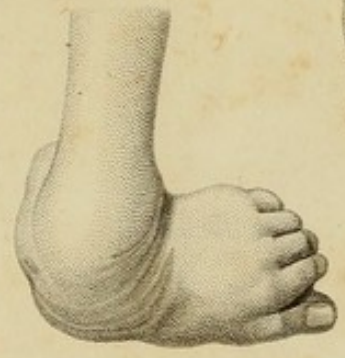


Fig. 7.



Plate LXXXVIII.

CLUB FEET.—SECTION OF THE TENDO ACHILLIS.

Fig. 1. *Various kinds of tenotomy knives.*—*a*, a tenotomy knife with the edge on the concave portion; *b*, another with the edge on the convex portion; *c*, a lance-shaped tenotomy knife with a double edge, for puncturing the skin.

Fig. 2. *Section of the tendo Achillis—Surgical anatomy.*—*a a'*, the two portions of the tendon which have been separated by the section; *b*, the sheath of the tendon formed in front by the intermuscular fascia which separates the superficial from the deep muscles; *c*, the tibial fascia forming the posterior portion of the sheath; *d*, a section of the skin, made for the purpose of exposing the parts which lie beneath.

Fig. 3. *Talipes equinus.*—The foot forms a line with the leg, resting upon the toes alone. The heel is drawn up by the contraction of the tendo Achillis.—*a*, the place of election, where the skin is punctured for the section of the tendon.

Fig. 4. *Operation of dividing the tendo Achillis;* position of the surgeon and assistant. The tenotomy knife *b*, being introduced through the wound *a*, is dividing the tendon from behind forwards.

Fig. 5. *Talipes calcaneus.*—The foot is forcibly flexed upon the leg, the heel alone resting upon the ground, while the toes are raised up.—*a a'*, points of the integument where the knife should be introduced, to effect a section of the extensor tendons of the toes.

Fig. 6. *Talipes valgus.*—The foot rests upon its inner side, while the outer side looks upwards, and the sole directly outwards.

Fig. 7. *Talipes varus.*—The sole is turned inwards, and very much bent from before backwards, the foot resting upon the outer side, while its inner side looks upwards.

CLUB-FOOT; SECTION OF THE TENDONS OF THE LEG AND FOOT.

All deformities of the foot, whether congenital or acquired, which

are classified under the title of *club-foot*, are accompanied by a contraction of certain muscles, tendons, or fasciæ. Subcutaneous tenotomy has been successfully applied to the cure of such deformities. There are several varieties of club-foot, all of which appear to be only an exaggeration of the normal movements of the sound foot, which is especially true in cases where the deformity is simple and recent; but when the disease reaches its utmost limits, the organ sometimes exhibits forms so singular, that they can scarcely be considered to have any analogy in the normal state.

Talipes equinus corresponds to *extension* of the foot, on which the heel is drawn up as much as possible; the foot, in this condition, lies very nearly on a line with the leg, the toes and extremities of the metatarsal bones alone resting upon the ground. Talipes equinus is produced by a contraction of the tendo Achillis, to which a well-marked contraction of the flexors of the toes is also added.

Flexion corresponds with *talipes calcaneus*, the opposite of the preceding; here, the heel alone touches the ground, while the sole of the foot looks directly forwards, the toes being curved upwards, and drawn towards the spine of the tibia. This variety, which is very rare, is produced by the contraction of the tibialis anticus, and the peroneus tertius muscles, and the extensors of the toes.

Adduction answers to *talipes varus*, the most common variety. The foot rests upon its outer side, while the inner side is directed upwards, and the sole looks inwards; the toes are usually strongly flexed, and the heel drawn upwards. This variety, especially when of long standing, is frequently combined with some of the other forms, generally with talipes equinus; it is produced by the contraction of the tibiales muscles, or the adductors, the gastrocnemii, and also by contraction of the palmar fascia.

Abduction constitutes *talipes valgus*, the opposite of the preceding. The foot here rests upon the inner side, and its usually concave shape is lost; the outer side is turned upwards, while most of the sole looks outwards. This variety is most frequently associated with talipes calcaneus, and is usually produced by the contraction of the peroneus longus and peroneus tertius muscles. The deformity known by the title of *flat-foot* is only a very slight form of valgus.

If contraction of the muscles is the most common cause of these deformities, their permanence cannot be attributed to it alone; the fibrous parts, the articular ligaments, the fasciæ, the sheaths of the

tendons contract, and lose their proper shape in the course of time, and their aid in perpetuating the deformity; the bones themselves become sub-luxated and deformed, by abnormal pressure upon each other, and finally lose their shape and relations to each other to so great a degree as to destroy all hope of cure; art, therefore, is frequently powerless in cases of club-foot where the deformity is excessive, and where the patient's age exceeds fifteen or eighteen years.

Operations may be performed at a much later period upon club-feet, when the alteration is simple and not strongly marked; in such cases, the patient may hope for an amelioration, if not for a cure.

Tenotomy, which is so valuable in the cure of club foot, ought always to be associated, in the treatment, with various kinds of apparatus, or machines which are intended to retain the member in its normal position. Kneading and rubbing the part with the hand is also frequently of benefit when associated with the other treatment.

The section of contracted muscles is performed in accordance with the general principles of tenotomy. We will run them over briefly, arranging them in two classes, in one of which the tendon is free, making a sensible projection beneath the skin, while in the other it lies closely in contact with the bone, retained in this position by a resisting fibrous sheath, and surrounded by a synovial membrane. In the first are included, the tendo Achillis, the tibialis anticus, the extensors of the toes, the tendons and superficial muscles of the sole of the foot, and also the bridles formed by the plantar fascia. In the second class are included, the tibialis posticus, the long flexors of the toes, and the peroneus longus and tertius.

Section of the tendons of the first class is effected in accordance with the following principles; a single puncture only should be made in the skin, which should be as small as possible—no longer than the instrument itself, which ought also to be as small as it can be made, consistent with the proper amount of strength. (Bonnet.)

The puncture should be far enough from the tendon to allow the wound to be made obliquely, and to leave it not liable to the penetration of air; this can be effected by raising up a fold of the integuments, and making the puncture at its base. (Jules Guerin.)

When the knife has been introduced as far as the tendon, it may be divided either from without inwards, or from within outwards; the first method is preferable, because the section can be aided by pressing upon the back of the instrument.

The knife is laid flat when introduced beneath the skin, and as soon as the middle of the blade has reached the tendon, the instrument is rotated so as to bring its edge in contact with the tendon, while its back looks towards the skin. Convex tenotomy knives are preferable to those which are straight or concave; two may be used, one straight and sharp-pointed, the other convex with a blunt point. During the introduction of the instrument, the tendon should be relaxed, so as to allow the blade to be easily slid between it and the skin; it must be put strongly on the stretch whilst the section is being made; an assistant giving the limb a proper position to produce this tension.

The section of the tendon is recognised by a sudden shock, accompanied by a peculiar sound; by the disappearance of the cord-like prominence formed by the tendon; and sometimes by an appreciable separation of the two divided portions.

With these general rules, we shall proceed to the description of the section of each particular tendon.

Section of the tendo Achillis.—This operation is performed for the cure of talipes equinus, but it is frequently indispensable in talipes varus et equinus, and even in the simple talipes varus of children. It has also been performed for very different affections, having been employed in the treatment of the deformity caused by contraction of the tendo Achillis after Chopart's operation, and also with success in cases of irreducible fractures of the leg.

Surgical anatomy.—The tendo Achillis is formed by the combination of the muscles which make up the calf of the leg; large above, its fibres, as it proceeds downwards, become condensed into a vertical cord, making a moderate prominence under the skin, which, for the extent of an inch and a-half, or two inches, at least, can be readily grasped by the fingers.

The point at which the fleshy fibres become tendinous, varies, but in the majority of cases it is not more than two inches above the os calcis. The tendon, at its inferior portion, spreads out laterally to be inserted into the tuberosity of the os calcis, from which it is separated by a bursa. In dividing this tendon, the surgeon should avoid wounding the bursa, and also keep clear of the fleshy fibres; the place of election is about an inch above the point where the tendon is inserted into the bone. In children the operation is performed about seven lines above the same point. There is another anatomical reason for the adoption of this locality. The tendon, posteriorly, is only covered

by the skin; anteriorly, however, it is in relation with the deep layer of muscles, and particularly with the tibial vessels and nerves, which are only separated from it by a fascia. In the vicinity of the tuberosity of the os calcis, the tendon is separated from the aforesaid organs by a very thick layer of fatty cellular tissue; both above and below the place of election, there is danger of wounding this bundle of blood-vessels and nerves. The instrument ought always to be introduced on the inner side to avoid all danger of wounding the blood-vessels.

The tendo Achillis is surrounded by a resisting fibrous sheath, into which both ends retract after the section, and which plays an important part in the cicatrisation of these divided ends. The second figure shows the relations of the tendon, and also the separation of the ends after the operation.

Method of operating.—The patient lies down upon his face, and an assistant grasps the central portion of the leg, and also the foot opposite the middle of the sole; he first relaxes the tendon to allow the knife to be easily thrust under the skin, and he then puts the muscle upon the stretch to facilitate the section; the surgeon standing on the inner side of the limb, makes a puncture of the skin with a lancet, or the sharp-pointed tenotomy knife, opposite the internal border of the tendon, and about an inch above the os calcis (fig. 3, *a*). The instrument, held flatwise, is now thrust between the skin and the projection caused by the tendon, and then rotated so that its edge is brought in contact with the posterior aspect of the latter, when pressure directly downwards, associated with a slight sawing motion, will divide the tendon, which creaks under the knife. A slight noise, a shock and the cessation of all resistance indicate that the section is complete. A deep depression can be frequently felt between the divided ends; the instrument is now carefully withdrawn, and two or three drops of blood escape; a small piece of adhesive plaster is applied to the wound. The apparatus is attached two or three days after the operation.

Section of the tibialis anticus.—This operation is useful in talipes calcaneus, and talipes varus. Bonnet, however, thinks that it is not required in the latter affection. The operation is performed at the point where the tendon is most markedly prominent under the skin, which is opposite the tibio-tarsal articulation and the head of the astragalus. The general principles which we have laid down must also be applied in this case; the surgeon must, however, proceed with

caution, and stop as soon as the division of the tendon is effected, to avoid penetrating the subjacent articulations.

Section of the extensor muscle of the great toe, of the extensor communis and the peroneus tertius.—This operation is performed for talipes valgus and talipes calcaneus. The decided projection which the tendons of these muscles make under the skin, renders their division very easy, by the ordinary method; they may be cut through one, or several punctures, made in front of the malleoli, and above the tibio-tarsal space (fig. 5, *a a'*). Bonnet prefers to make the section opposite the metatarso-phalangeal articulations, there being less danger of wounding the blood vessels and nerves of the dorsum of the foot. The section of the various extensor tendons is made at the same time.

Section of the plantar fascia.—Contraction of the fasciculi of this dense fascia is very common in talipes varus; the most marked projection made by these fibrous bridles is usually opposite the articulation of the first with the second row of tarsal bones; they are divided in the ordinary way, from without inwards; the numerous lateral and deep prolongations presented by this fascia, render its complete section very difficult, and the results of the operation are not always immediately apparent; although the occasions for doing so are very rare, yet the modes which we have already described for a division of the palmar fascia may sometimes be advantageously adopted in operations on this region.

We shall say nothing concerning the section of the muscles lying upon the internal and external prominences of the sole of the foot; these operations are usually imperfect, or at least are very uncertain and ill-regulated.

The section of the tendons of the short flexor is made at the same time as that of the long flexors, opposite the anterior portion of the plantar aspect of the first phalanges of the toes.

The peroneus longus and brevis, and the tibialis posticus, constitute a second class of muscles, which being closely connected with, and in fact held in position near the bone, by resistant fibrous sheaths, make no marked projection under the skin, when contracted. Their section is effected differently from that of the other muscles; it has been recommended that the surgeon, after making the puncture of the skin in the usual way, should slide a sharp-pointed convex tenotomy knife beneath them, and make the section from within outwards; the

section from without inwards, which we have recommended as most appropriate for the other muscles, might, if performed upon these tendons, endanger the articulations and blood-vessels; but as a set-off to this is the difficulty experienced in sliding the knife between the tendon and the sheath inclosing it, which renders the operation laborious and uncertain.

Section of the peroneus longus and brevis.—There are three localities where this can be performed: 1st. Behind the fibula, about two-thirds of an inch above the upper part of the external malleolus, where the operation can be performed from without inwards without danger; but, as the fleshy fibres extend far downwards, the section must be extensive.

2d. These tendons may also be divided about the third of an inch below the external malleolus, very near the place where they take a curve to be reflected forwards; there is danger here of opening the tibio-tarsal articulation, on which account we give the preference to the first method.

3d. The operation may be performed immediately behind the malleolus; but the surgeon experiences great inconvenience on account of the prominence of the bone on either side of the groove in which the tendons run. Section of the peroneal muscles is performed for talipes valgus, and, according to Bonnet, it has proved serviceable for flat feet.

Section of the tibialis posticus.—This operation is performed for talipes equinus, and for talipes varus in adults, the methods varying according as the deformity is slight, or well-marked. In talipes equinus, the tendon may be divided behind the malleolus; but the operation is uncertain, and it is better to perform it below the malleolus in the following manner: the tuberosity of the os scaphoides being well made out, the knife is thrust in about the third of an inch above, and in front of it, until it comes in contact with the astragulus; it is then slid along this bone until the point is carried two or three lines below the tuberosity of the scaphoid, the edge being kept in front; by following these details the tendon is divided; the common flexor of the toes is usually divided at the same time. (Bonnet.)

When, as in well-marked talipes varus, the scaphoides touches the malleolus, the muscle does not extend down upon the foot; section behind the malleolus is then to be preferred, but the result is always uncertain; if the knife be thrust in too far, there is danger of wound-

ing the posterior tibial artery, an accident which has frequently happened, although without any very serious results.

Section of the flexor proprius of the great toe, and of the flexor communis of the toes.—The very deep position of these muscles will not allow of their being divided, either in the vicinity of the malleoli, or in the sole of the foot; their section, therefore, must be made opposite the first phalanx of the toes. The methods advised for muscles belonging to the first class, are the only ones appropriate to this operation; a puncture and section must be made opposite each toe, the only inconvenience being the additional time required for performing the operation. The same remarks apply to the flexor brevis of the toes. It frequently happens that both the long and short flexors are divided at the same time, which, in fact, is generally indicated by the existence of simultaneous contraction of both muscles.

THE END.

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